



ANDAMAN AND NICOBAR ISLANDS UNION TERRITORY BIODIVERSITY STRATEGY AND ACTION PLAN

R. S. C. Javara & H. V. Andrews
Editors

ANDAMAN AND NICOBAR ISLANDS UNION TERRITORY BIODIVERSITY STRATEGY AND ACTION PLAN



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LIST OF ABBREVIATIONS USED

ANI	—	Andaman & Nicobar Islands
AN DE & F	—	Andaman & Nicobar Department of Environment and Forests
ANIFPDC	—	Andaman & Nicobar Islands Forest Plantation & Development Corporation
AAJVS	—	Andaman Adim Janjati Vikas Samiti
AH & VS	—	Animal Husbandry and Veterinary Sciences.
ANET	—	Andaman & Nicobar Islands Environmental Team
APWD	—	Andaman Public Works Department
ASI		Anthropological Survey of India
ATR	—	Andaman Trunk Road
BSI	—	Botanical Survey of India
CARI	—	Central Agricultural Research Institute
CCF	—	Chief Conservator of Forests
CWLW	—	Chief Wildlife Warden
DOD	—	Department of Ocean Development
DRDA	—	District and Rural Development Agency
EIA	—	Environmental Impact Assessment
FCI	—	Food Corporation of India
FD		Forest Department
FSI	—	Forest Survey of India
GCRMN	—	Global Coral Reef Monitoring Network
GEF	—	Global Environment Facility
GIS	—	Geographic Information System
GPS	—	Global Positioning System
IBA	—	Important Bird Arcas
ICFRE	—	Indian Council of Forestry Research and Education
ICRMN	—	Indian Coral Reef Monitoring Network
IIPA	—	Indian Institute of Public Administration
IP & T	—	Information, Publicity & Tourism
IUCN	—	International Union for the Conservation of Nature
JFM	—	Joint Forest Management
JNRM	—	Jawaharlal Nehru Rajkceya Mahavidyalaya
MGMNP	—	Mahatma Gandhi Marine National Park
MHNP	—	Mount Harriet National Park
NBRI	—	National Botanical Research Institute
NTFP	—	Non-Timber Forest Produce
NGO	—	Non-Governmental Organization
PA	—	Protected Area
PF	—	Protected Forest
RF	—	Reserved Forest
RJMNP	—	Rani Jhansi Marine National Park
SACON	—	Salim Ali Centre for Ornithology and Natural History
SANE	—	Society for Andaman and Nicobar Ecology
SAP	—	Strategy and Action Plan
TPCG	—	Technical Policy Core Group
UNDP	—	United Nations Development Programme
WII	—	Wildlife Institute of India
WLPA	—	Wildlife (Protection) Act, 1972
WWF	—	World Wide Fund for Nature
ZSI	—	Zoological Survey of India



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FOREWORD

Biodiversity is the sum total of the variety and variability of plants, animals and microorganisms. The essential goods and services provided by the biological resources of our planet depend on this variety and variability of genes, species, populations and ecosystems and the continued interaction among them. The biological resources provide us the food, clothing, housing and medicines, but as a result of human activity especially overexploitation, there is a decline in the biodiversity and this is posing a threat to human development and even existence. The loss of biodiversity arises mainly from the habitat destruction, overexploitation of biological resources, pollution and inappropriate introduction of exotics. The complexity of the interactions between the species in a natural ecosystem is such that any disturbance is likely to lead to a loss of species or at least its genetic variants, which is a permanent loss to nature and mankind.

Realizing the importance of biodiversity, India has signed the Convention on Biological Diversity and now it is mandatory on our part to take all efforts towards conservation and sustainable utilization of biodiversity. In order to regulate the exploration and commercial exploitation of biodiversity of this country, to prevent biopiracy and to safeguard our traditional knowledge in the form of Intellectual Property Rights the Government has already come up with a Biological Diversity Act, 2002.

Andaman and Nicobar Islands constitute one of the hotspots of biodiversity with a variety of ecosystems such as tropical forests, wetlands, mangroves and coral reefs. The forests of these islands are one of the richest in the country in terms of biodiversity and a large part of them still remain unexplored. Scientists have described more than 5100 animals, including 52 mammals, 244 birds and 76 reptiles. Of the mammals 63% are endemic to these islands and the same way 39% of birds and 32% of reptiles are endemic. Of the 2200 flowering plants described so far, 14% are endemic to these islands and 40% of the non-endemic are not found in mainland India. Thus every second flowering plant found in these islands is not found in mainland India, and for this reason it is veritably a botanist's paradise.

Biodiversity Conservation has been accorded the highest priority in the forestry research programmes for these islands in the National Forestry Research Plan and accordingly the Department of Environment and Forests has carried out collaborative projects on biodiversity inventorisation, characterization and utili-

zation. For inventorisation of the native flora collaborative projects have been started with Forest Research Institute, Dehra Dun. In collaboration with the Dept. of Space characterization of biodiversity at landscape level has been carried out to identify biodiversity rich spots which are under threat or degradation due to human interference. This shall help in management interventions by strengthening of protection machinery in those areas or bringing such areas under the Protected Area Network. For utilization of the biodiversity of this area for the benefit of the local people a project on inventorization of medicinal plants has been carried out in collaboration with the National Botanical Research Institute, Lucknow. More such projects are in the pipeline for strengthening of our knowledge on the diversity of the flora and fauna of this territory.

More of such research is required in the field of agro-biodiversity and biodiversity of domestic animals, in order to utilize the genetic potential of the wild relatives of domesticated plants and animals. When the rice fields from India to Philippines were once affected by a serious wilt problem on an epidemic scale, it was a wild rice called *Oryza nivara* from our country which provided the gene resistant to the disease and saved these countries from disaster. A species of wild rice namely *Oryza inandamanica* has been found in these islands also, and its genetic potential remains to be tapped. For coconut, these islands fall within the zone of natural distribution and a large number of variants are noticed here. Rightly for this reason the World Coconut Germplasm Collection has been established here. These islands alone have the native populations of *Casuarina equisetifolia*, one of important plantation species of the country, extensively cultivated along the East Coast of the country. Characterization of these germplasms for productivity or resistance to pests and diseases can help in breeding of these species and increasing their productivity to a large extent.

In order to collate all the areas of research in biodiversity and to apply the same for the purpose of conservation the Ministry of Environment and Forests initiated action for preparation of a Biodiversity Conservation Strategy and Action Plan. For these islands the Andaman & Nicobar Islands Environmental Team, a Non-governmental organization in association with the Department of Environment and Forests has prepared this Biodiversity Conservation Strategy and Action Plan. This has been prepared after extensive consultation with all the stakeholders. The success of the effort lies in follow up actions indicated therein by all the agencies dealing with biological resources.

S. R. MEHTA, IFS

1. Executive Summary

1.1. The planning process

The BSAP process for the Andaman and Nicobar Islands was initiated in October 2000 with the constitution of a Steering Committee vide A & N Administration's Order No. F. 16 (G- 1)/19- 642 dated 6- 10- 2000 and the appointment of ANET as the Nodal Agency for preparing the SAP. A Working Group was constituted by ANET and the AN DE & F to prepare the BSAP and the first meeting of the Working Group was held during December 2000. At this meeting ANET presented the BSAP process, methods and submitted a statement of issues and problems to initiate the process of the BSAP for the Andaman and Nicobar Islands.

The Working Group met several times until meetings were abandoned due to lack of quorum. A draft report was prepared by ANET, and was circulated to all the members of the Working Group for comments as suggested by the Chief Wildlife Warden, the Member Secretary, BSAP, Steering Committee. On December 10, 2001, a meeting at the Department of Environment and Forests (AN DE & F) convened by the CCF went over this draft and the draft was then substantially modified and expanded.

A final meeting was held on April 12, 2002, chaired by the Chairman, Steering Committee (PCCF & Secretary, AN DE & F). This meeting was represented by the Vice Chairman (CCF), Member Secretary (The CWLW, ANI), Dr. Wafar, NBSAP Technical Policy Core Group (TPCG), and members of the working group, several officers from the AN DE & F and from various other departments in the islands. The final draft report that was prepared by ANET was reviewed and discussed in detail. After the review and discussions it was decided that a Drafting Committee be constituted. This five-member, AN DE & F, BSI, ZSI and ANET representatives, committee met on various occasions and finalized the SAP final draft report.

Various reports and documents were reviewed, and intensive literature search was conducted by ANET to keep the SAP docu-

ment current and updated. All lists in the document have been compiled and updated from existing literature.

1.2. Key issues and recommendations

One of the most important issues in the conservation of biodiversity is the assessment of biodiversity itself. Recently, the Department of Space, Government of India and the Department of Environment & Forests have jointly characterized the biodiversity at landscape level using satellite imagery. The study has created a database on a GIS platform providing information on forest cover and density, forest types, land use, biological richness, fragmentation and disturbed areas. Information from this study will help in identifying areas of priority for conservation and to strengthen protection machinery in the areas of disturbance. However, the study is limited only to the higher plants and information is required on the lower-plants as well as for other fauna. Additional studies are required for assessment of species diversity as well as genetic diversity within the species. Assessment of biodiversity and continuous monitoring at periodic intervals is essential for conservation.

Certain policies undertaken by the Government as well as the public in the ANI were found to have adverse effects on the biodiversity. One of the most important issues identified was allowing the increase in human population, caused to an extent by immigration from other parts of the country, which is exerting pressure on the natural resources and ecosystem of the islands. As a consequence of this rapid increase in population there is a demand for various amenities essential for economic well being, which has led to exploitation of various natural resources, to an unsustainable level in certain cases. For example, sand mining resulting in loss of beach vegetation and nesting habitats of marine turtles is a major issue. Tourism is also identified as a cause of concern and steps are needed to make it environmentally sustainable. Logging is a contentious issue with the recent order of the Supreme Court permitting logging only for meeting the local requirements (Appendix 1).

Encroachment on forest land is a major problem and is impacting biodiversity by fragmentation of the habitats. The Supreme Court has ordered eviction of encroachments and also suggested restrictions on immigration. These measures, when implemented, will reduce the threat to various habitats. The threat posed by the introduced species is also a major concern, especially in the island ecosystem, which has a high degree of endemism and site-specific flora and fauna. Site-specific threats are shown in Appendix 2.

In terms of research, the priority is on a detailed survey of all major taxa for quantification of the species diversity and estimation of their distribution and abundance. The endangered and endemic species will require additional research inputs.

Action Plans are presented for each sector, largely based on the ongoing programmes. Implementation of these, will substantially improve the conservation of biodiversity in the territory. For each sector, the various actions to be taken, the implementing agencies, the time frame, the rationale and key methods are enumerated for each.

2. Introduction

2.1. Scope of the SAP

This SAP covers the Andaman and Nicobar Islands. These are a Union Territory belonging to India, and lie between 6° 45' N to 13° 41' N and between 92° 12' E to 93° 57' E. Also considered are the territorial waters and the Exclusive Economic Zone, since the long-term preservation of marine and coastal and other terrestrial biodiversity is critical to the well being of these islands.

2.2. Objectives of the SAP

The objectives of the SAP were to identify the problems relating to biodiversity conservation and use, identify the ongoing programmes re-

lating to biodiversity conservation and utilization of biological resources, both from the Government sector and from other stakeholder groups, identify the stakeholders, identify the gaps in the coverage, and finally propose actions to fill in the gaps both in knowledge and in vision.

2.3. Methodology used

The information required for preparing the SAP was obtained through several meetings with the Government departments and other stakeholders. Extensive literature survey was made to make the document as current as possible and enhanced. The following documents have been consulted in preparing this report:

- The State Forestry Action Programme
- Coral Reef Management Plan- UNDP and the AN DE & F.
- Tourism plan- WTO/UNDP.
- State Forestry Research Plan - AN DE & F.
- Tenth Five-Year Plan (2002-2007) of Environment & Forests Sector- AN DE & F
- National Forestry Research Plan- ICFRE
- Protected Area Management Plans- AN DE & F
- The Forest Statistics 1997- 1998, 1998-1999 & 2000-2001-; 2005 AN DE & F.
- The Andaman and Nicobar Islands - Forests and Environment- AN DE & F.
- Setting biodiversity conservation priorities for India- WWF (India)
- Sustainable management of Protected Areas in the ANI - ANET & IIPA.
- Master Plan for primitive tribes in ANI- ANI Administration.
- Proc. of the seminar "Planning for Protected Area Management in the Andaman & Nicobars".
- Biodiversity characterization at landscape level in Andaman and Nicobar Islands using satellite remote sensing and Geographic Information System- IIRS.

In addition certain studies conducted by ANET provided useful information (Box 1).

Box 1. ANET studies and key conclusions

1. A study on the shark fin industry: This study of ANET indicates that the bulk of shark catches are by big trawlers. Artisan fishermen catch relatively less even though more people are involved.
2. Two studies on feral animals: Studies on elephant and chital, their impact on island ecosystems and forest regeneration. Results show that in the case of elephants damage due to debarking is now occurring on tree species that were previously not eaten, due to the reduction in food resources. This has led to damage to the forest. The study on chital indicates that seedling regeneration is much lower in areas where chital are found, irrespective of past management practices (Ali, 2004; Aul, 2002a). These both indicate potential damage to regeneration, which can change the floristic structure, suggesting that control measures are necessary.
3. Socio-economic profiling of the villagers, who live adjacent to the MGMNP indicates that the benefits from the park are going largely to outsiders and recent immigrants (Singh et al., 2001).
4. A study of agricultural yields in South Andaman: This study showed a pattern of declining productivity that has been documented earlier for North Andaman. However there is currently surplus rice grown in the Andamans and there is no market for it. Food Corporation (FCI) of India will not buy this rice as it is of sub-standard quality and the surplus is mainly due to the increased land area for rice production through encroachments.

3. Area profile

3. 1. Geographical area

The Andaman and Nicobar Islands are the largest archipelago system in the Bay of Bengal, consisting of 306 islands and 206 rocks and rocky outcrops and are latitudinally situated between 6° 45' N to 13° 41' N and longitudinally 92° 12' E to 93° 57' E. The total geographical area is 8, 249 km² with a coastline of 1, 962 km. The northern group of islands, the Andaman group, is 6,408 km² and the Nicobar group is 1,841 km². This large archipelago is separated from mainland India by almost 1000 km; the nearest landmass in the north is Myanmar, roughly 280 km north of Landfall Island, the northern-most island in the Andaman Group. The closest landmass to the Great Nicobar Island is Sumatra, 145 km south (Fig. 1).

The Great Andaman group of islands is made up of North, Middle and South Andaman Islands; with Baratang Island situated between

Middle and South Andaman Islands. Ritchie's Archipelago, a group of islands, is located east of Middle Andaman and Labyrinth group of islands is situated southwest of South Andaman. Rutland lies southeast of South Andaman and Little Andaman Island 55 km south of South Andaman, across the Duncan passage. The land area of 6408 km² of the Andaman Group constitutes almost 90% (5629 km²), as reserve or protected forest of which 36% is Tribal Reserve (Fig. 2). The elevation in the Andamans is 0- 732 m, Saddle Peak in North Andaman Island being the highest.

The Nicobar group is spread over an area of 1841 km² of which 1542 km² are recorded forests. The Nicobars are separated from the Andamans by the 10° Channel, a wide gap of 160 km with heavy tidal flows, making sea transport by small boats difficult. The Nicobars consist of 24 islands in three distinct clusters of which 12 are inhabited with 170 villages and hamlets. The Northern Group consists of Car Nicobar and Batti Malv and the central or

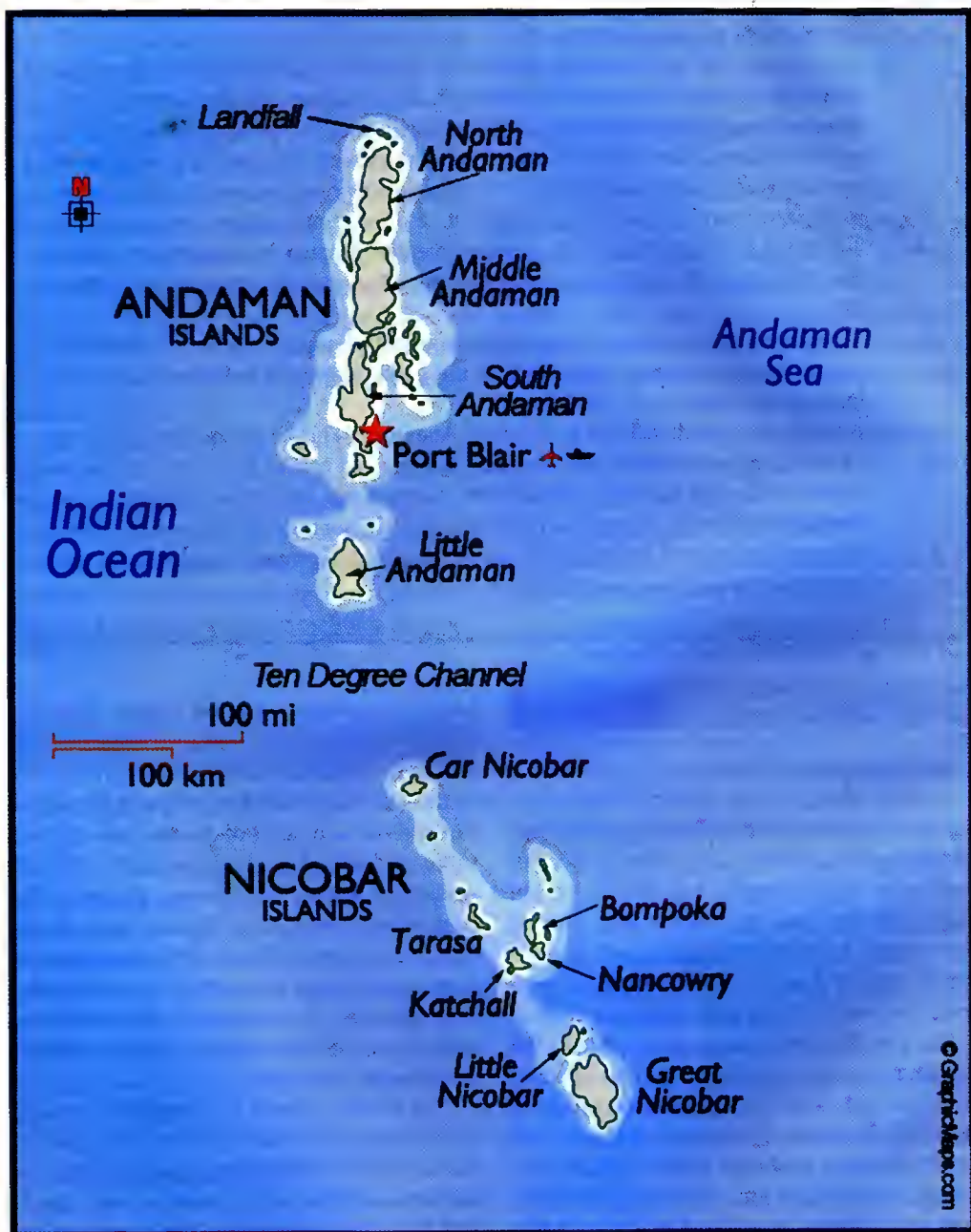


Figure 1. The Andaman & Nicobar Islands

the Nancowry Group, consists of Tillanchong, Chowra, Teresa, Bompoka, Trinkat, Kamorta, Katchal and Nancowry. The southern group consists of the two large islands Little and Great Nicobar, together with Pigcon, Megapode, Kondul, Pilo Milo, Menchal, Treis, Trak and Meroc Islands (Fig. 3). The entire Nicobars is a Tribal Reserve and has four Sanctuaries, three of which are islands. An area of 885 km² in Great Nicobar Island is designated as the Great Nicobar Biosphere Reserve and two other areas within it as national parks; Great Nicobar Island also has the highest peak in the Nicobar group, Mount Thullier that is 670 m in height. (Pande, et al, 1991; Das, 2001; Andrews & Sankaran, 2002).

3. 2. Geology

The Andaman and Nicobar archipelago lies in a crescent that stretches from Cape Negrais of Myanmar to Banda Arc of Sumatra (Indonesia). The Andamans are considered to be the extensions of the submerged Rakhine Yomas (Arakan Yomas) range of Myanmar, a southward trending branch of the eastern Himalayas that merges in the north with the ranges in north-east India, which forms a complex of sub parallel north-north-east trending ridge. The same ridge rises 135 km south of the Irrawady, in the Bay of Bengal. The Mentawai Island to the south and south-west of Sumatra are presumed to be a southern continuation of the Nicobars (Rodolfo, 1969; Weeks et al., 1967; Das, 1999). The Nicobar group is considered to be of volcanic origin, with coral reefs contributing to the upheaval of banks (Hochstetter, 1866, Tipper, 1911). The Ritchie's Archipelago, Baratang, Interview and the Cocos are considered to be truncated parts of the Rakine Yomas (Arakan Yomas). Narcondam, a 7 km² island and which is 710 m above MSL, is an extinct volcano, situated ca 70 km south of the Irrawady delta shelf and east of North Andaman Island. The origin of this island is believed to be from a single eruption and dated Late Pliocene to Pleistocene (Chibber, 1934; Das, 1999). Barren Island, with an active volcano, lies 135 km south-southwest of Narcondam (Fig. 2).

Chemical analysis and norms of the basaltic and andesitic rocks of Narcondam and Barren indicate their origin to a common magma (Washington, 1924). The rocks are highly folded due to frequent tectonic movements in the past and geological formations represent thick layers of marine sediments ranging from late Mesozoic to Quaternary age (Karunakaran et al, 1968) and the present configuration probably took shape only 26 million years ago. Oldham (1885), Gee (1925), Rudolfo (1969), Rajashekhar & Reddy (2002), and Chandra et al., (1999), Srinivasan (1979, 1986), Srinivasan & Azmi (1979), has previously discussed the geology, fossils and hydrology of these islands. The soils of ANI are of three orders, Entisols, Inceptisols and Alfisols, and the six sub orders are Orthents, Fluvents, Psamments, Aquepts, Ochrepts and Udalfs (Singh and Mongia, 1985; Singh, et al., 1988; Gancshamurthy et al., 2000). These islands are also seismic and have been discussed by Kumar and Bhatia (1999).

3. 3. Climate

The Andaman and Nicobar archipelago is situated in the equatorial belt and are exposed to marine influences and have a tropical climate, warm, moist and equable. The temperature ranges from 18°C to 35° C. The proximity of the sea and the abundant rainfall prevents extremes of heat and these islands experience both the Northeast and the Southwest monsoons. The southwest monsoon commences during April/May accompanied by high winds with heavy downpour right through July to September. The northeast monsoon usually commences during October and rains continue into December. The average annual rainfall ranges from 3,000 to 3,500 mm and humidity varies from 66% to 85%. In some years the islands experience rains during all the months of the year. Cyclones occur during the monsoons, accompanied by very strong winds, mainly during May and November and in some years during mid April. A comparative study on temperature and rainfall of the Andamans has been previously discussed by Chakravarty et al. (1987).

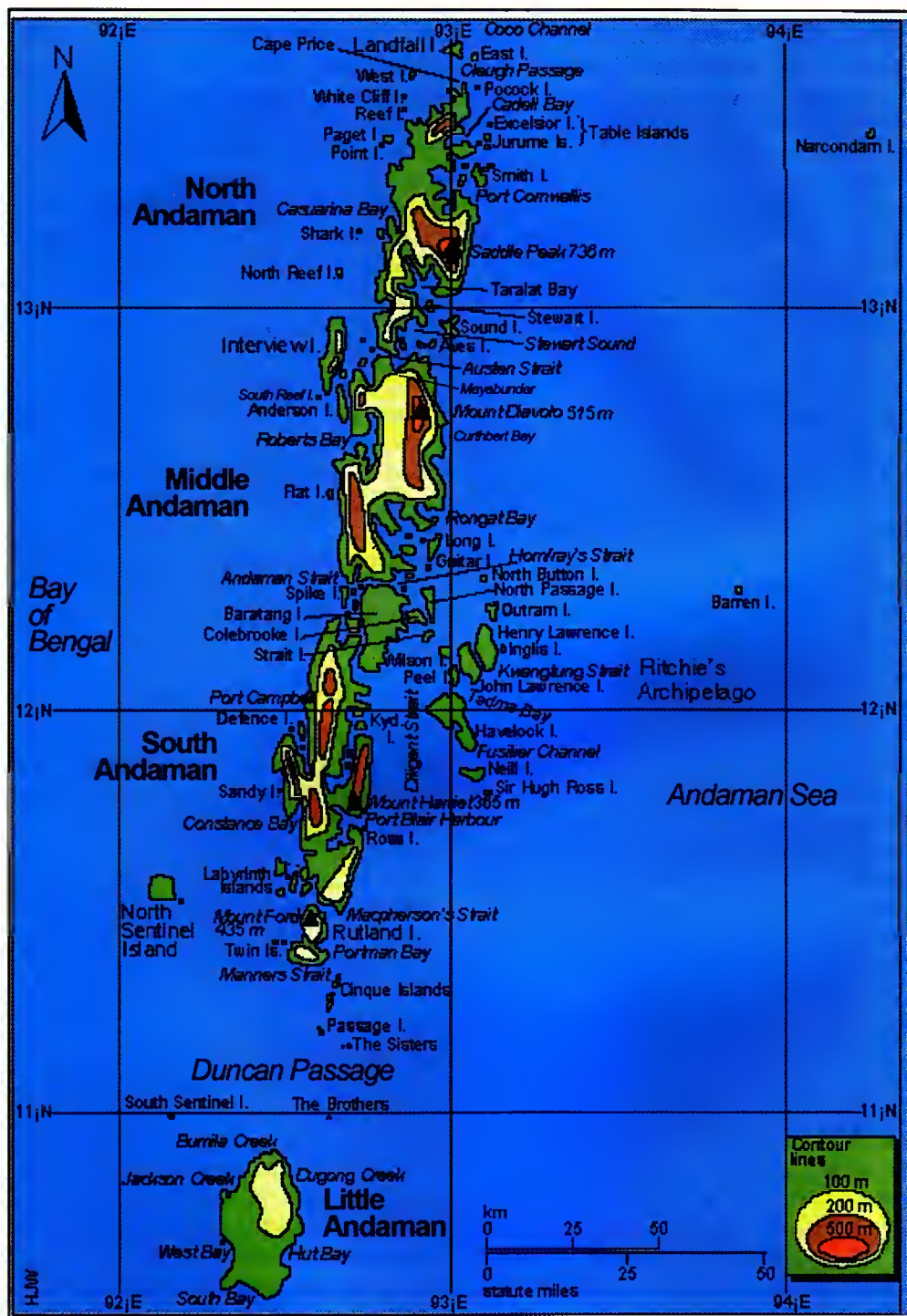


Figure 2. The Andaman Islands.

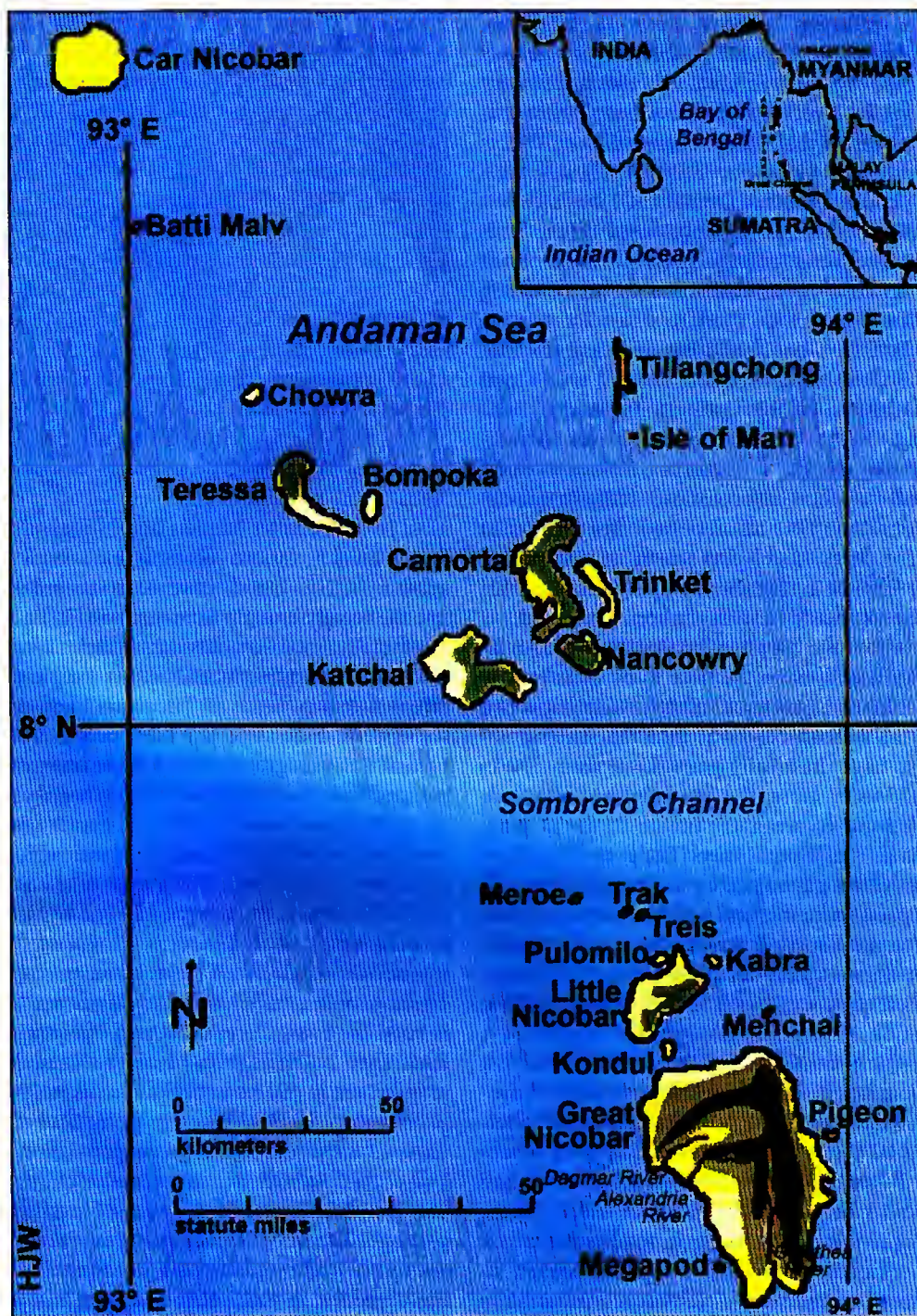


Figure 3. The Nicobar Islands.

3. 4. Socio-economic profile

The Andaman Islands were home to several groups of Negrito, hunter-gatherer indigenous tribes. The most important in the last century were the Great Andamanese people, consisting of 12 tribes that included different sects (Portman, 1899; Cooper, 2002). These groups of people numbered around 6000 in the 1850's when the islands were colonised by the British for a penal colony. The British attempted to 'civilise' the Andamanese people, teaching them to eat exotic food, to wear clothes, live in houses, schools, and hospitals and to farm. These experiments failed, and led to the total decimation of the Great Andamanese (Portman, 1899). The current number is 34 individuals, who have been marginalized to Strait Island on southeast coast of Middle Andaman. Portman (1899) has reported this process in great detail, and very clearly mentions that the British, in all their attempts, failed and this process should have never been attempted.

The Onge people, who inhabit Little Andaman Island, were the next to be contacted in 1920, and a process similar to what happened to the Andamanese was initiated. Their numbers have drastically gone down from 500 in 1920 to 97 currently. The Onge are now confined to two areas, the mouth of the Dugong Creek and South Bay. Their culture, their movement patterns, their camps, problems and impacts to their island and their resources, has been previously discussed by several authors (Swaminathan et al., 1971; Basu, 1990; Davi, 1990; Cooper, 1992; 2002; Pandya, 1993; Reddy, 1994; Andrews, 2000b).

The Sentinelese and the Jarawas, the other two tribes in the Andamans, have resisted contact until the 1960's. The Sentinelese, numbering 100- 150 (estimated), have for long inhabited North Sentinel Island, an island 60 km² south west of South Andaman Island. These people have been living in total isolation for over hundreds of years except for contact attempts made by the A & N Administration in 1967, 1991, 2000 & 2004. However there is a lot of disturbances around their island, due to intensive fishing, lobster collection and Myanmar poachers, who dive for sea cucumber and

shells. The current status of the Sentinelese is not yet known.

The Jarawas are confined to the west coast of South and Middle Andaman Islands. The contact with this tribe and its impacts has been previously discussed by Portman (1899), Bonington (1931), Chengappa (1958), Sarkar (1990), Reddy (1994), Andrews (2002) and Chandi (2002). The contact process with some of the Jarawa people was begun in 1974 and they continued to remain hostile till 1999. Now, the contacts have increased compared to the past and this has become a matter of major concern. The current distribution of the indigenous groups in the Andamans is shown in Figure 4.

The Nicobarese, people of Mongoloid origin, occupy 12 of the 23 Nicobar group of islands. Some of them live in small villages, but most live in smaller hamlets and in individual family units in various locations and islands. A number of Nicobarese have been assimilated into the society brought from mainland India almost totally, but resent outsiders in their islands. Although until now, most Nicobar people are referred to, in general, as 'Nicobaris'; however it should be understood that these people are of several different groups with different customs, cultures and separate dialects. These people are probably descendants of different hunter-gatherer from Indo-Malayan and Myanmar regions (Andrews & Sankaran, 2002).

The Shompen, numbering 380 and of Mongoloid origin, are confined to the inland forests and the east coast of Great Nicobar Island. These people numbered in thousands and inhabited the coastal areas of Great Nicobar Island. Their numbers probably got reduced due to influenza in 1918 and poliomyelitis in 1947 (Chengappa, 1953). Currently their status still requires attention, as the male population is higher than the female, and as males outnumber females there are few women of marriageable age. The Shompen are being subjected to the forces of assimilation similar to those the tribal groups in the Andamans have already undergone.

The next group of interest are the descendants of the convicts and freedom fighters, who were jailed in these islands. They brought with

pointed for the islands, and he was the Administrator of these islands. This post was later upgraded to that of Lieutenant Governor. There was an elected council of five counsellors that looked after various portfolios. This has been replaced by the Panchayati Raj, of which a 3-tier system exists- with Zilla Parishad at District level, Panchayat Samiti at middle level and Panchayat at the village level. The islands have one Member of Parliament in the Lok Sabha who plays a key role in deciding the policies to be adopted here.

3. 6. Ecological profile

3. 6. 1. Land use

Until independence in 1947, the Andaman Islands retained most of its forest cover. There was very little demand for timber during the colonial period. A saw mill established in 1883 supplied timber to settlers around Port Blair. Later in 1926 WIMCO set up a matchstick factory in Port Blair. There were only small areas during this period that had been cleared, in extreme South, Middle and North Andaman Islands (Khan, 1983).

The 1950's saw an explosion of settlements as people flooded in. While during the war years and immediately thereafter from 1942 to 1952, there was no forestry operation, this was resumed and expanded, primarily to make land available for the colonisation/rehabilitation operations and to meet the industrial demands in mainland, especially of the Indian Railways. The tribal reserves for the Jarawa and the Onge that were notified in 1957 had large portions de-notified in the 60's and 70's as there was pressure for land for settlement. A second de-notification was for the construction of the ATR (Sarkar, 1990; Reddy, 1994). Later, 20,000 ha from the Onge Reserve in Little Andaman Island were de-notified of which 1600 ha was used for red oil palm plantations (Basu, 1990; Reddy, 1994; Andrews, 2000b).

The forests in the ANI group occupy 6264 km² or 84.4% of the total geographical area of 8,249 km². Of this, 5387 km² is forests in the Andaman group and 1577 km² in the Nicobar group. Of the total geographic area, very dense

forest with more than 70% canopy density constitutes 42%, dense forest with canopy density between 45% and 75% constitutes 34%, open forest with crown density between 10% - 40% constitutes 8% and non-forest most forest land forms 16% (FSI, 2003). The legally notified forest is 7170.69 km², (86.93% of the geographical area); of this, 4,242 km² are protected forests and 2,929 km² are Reserved forests (AN DE & F, 2001).

The remaining 14% of land is revenue land and is used for human settlements, agriculture and other human based activities. Most of the revenue land is along coastal areas where people are settled. The entire coastal area is under CRZ-IV (Coastal Regulation Zone- category IV), and reclassification into CRZ-1 and CRZ-II is being formulated. Revenue land only 21% is under intense cultivation and another 11% is classified as fallow land and cultivable wasteland, plantation crops cover 45% of the revenue land (Sirus, 1999).

3. 6. 2. Forestry

The notified forest area in the islands is 7,170. 69 km² and of this 41% area is under Tribal Reserves. The primary objective of Forest management had been protection of the forest ecosystem, and secondly meeting the requirement of local industries and the people settled here under various colonization schemes.

For the purpose of timber extraction and regeneration of forests, two methods were adopted. The selection system and clearfelling systems, finally, after repeated experiments, the Andaman Canopy Lifting Shelterwood System was thought suitable and this system, proposed by B. S. Chengappa, was continued for forestry operations (Chengappa, 1934, 1937a, 1937b, 1944). This was meant for enhancing the value of the forest in commercial terms, and commercial species were encouraged, in tune with the then National Forest Policy of 1952. This, as envisaged, resulted in a change of the forest composition and diversity and studies in specific areas show that these changes have occurred (Pandit, 1991). From a biodiversity point of view, the number

of species might have declined through using this system, besides causing change in microhabitats. Several species of amphibians, plants, insects and freshwater fish might have been lost, in the area set aside for production forestry. Approximately 30% of the forest area was set aside for production forestry and regeneration through Andaman Canopy Lifting System, leaving 70% of the area totally protected in the Protected Area Network. This includes tribal reserves, and remains undisturbed except for interference from settlements. Of the area set aside for working, about 50% has been worked till 2001, and the balance area may not be worked in view of the recent orders of the Supreme Court. The changes are particularly evident wherever there are large densities of introduced herbivores such as the Chital (*Axis axis*) in the Andamans, (Aul, 2002a; Ali, 2004). This is particularly obvious in the South, Middle and North Andamans, including some of the outlying islands (Andrews & Sankaran, 2002).

Settlement has also resulted in the loss of most of the lowland evergreen forest, and small freshwater riverine habitats, which include most of the Andaman teal and crocodile nesting habitats in the Andamans (Andrews & Whitaker, 1994a,b; Vijayan, 1996a; Vijayan, 1997; Andrews, 1999; 2000c; 2001). These flat lands close to freshwater streams were thought to be the most suited for agriculture and were preferentially cleared. There is, currently, very little of the lowland forest type left in the Andamans except in Protected Areas and in the Jarawa Reserve along the west coast of South and Middle Andaman Islands.

The Nicobar Islands, on the other hand, have had a long history of horticulture, and sections of coastal forests were selectively cleared to an extent by the Nicobari people to let coconut trees regenerate together with other forest species that are utilized from time to time, either for food or construction. Since 1996 clearings have occurred on the south east coast of Great Nicobar Island and in the Nancowry group. Clearing here has also concentrated on coastal lowland forest. This, in turn, has affected the habitat of important endemic birds such as the Nicobar Megapode, (Sanka-

ran, 1995a) as well as Giant Robber Crab, salt water crocodiles and sea turtles on the south east coast of Great Nicobar Island (Andrews et al., 2001a; Andrews & Sankaran, 2002).

3. 6. 3. Endemicity

One of the major significance of ANI is not only the species richness but also the high level of endemism. Overall, 9% of the fauna is endemic including 40% of the 244 species and subspecies of birds are endemic (Appendix 3). In mammals, 60% of the 58 species are endemic. The ANI supports a significant diversity of reptile and amphibians with a high level of endemism. Currently 7 amphibians and 16 reptile species are endemic to the Andamans and 2 amphibians and 15 reptiles are endemic to the Nicobars. (Das, 1994, Andrews and Whitaker, 1998; Das, 1999; Andrews, 2001; Andrews & Sankaran, 2002) (Appendix 4 & 5). Representing 700 genera and belonging to 140 families, about 14% of the angiosperm species are endemic to the islands. Among the non-endemic angiosperms, about 40% are not found in mainland India, but have only extra-Indian distribution in South East Asia. (Rao, 1996) (Appendix 6). There are 120 orchid species reported from both island groups, of which eight are listed as rare and endangered. Ellis (1987) reported 120 species of pteridophytic flora from 36 families for both island groups. Awasthi and John (1987) recorded 51 resource potential species from Great Nicobar Island as having 21 uses and Ellis (1989) reported some more exploitable plants species.

The butterfly diversity and endemism is also very high. Of the 214 species and 236 subspecies in 116 genera, over 50% are endemic (Khatri, 1993). Although there are no large mammals other than the wild pig in the ANI, there are several small mammals and several of these are endemic (Appendix 8). This endemism is due to the isolation from mainland Asia (Das, 1999). Considering the size and area of the islands, loss of habitat leading to extinctions will have far greater consequences in terms of the loss of genetic diversity than comparable areas elsewhere. A rough calcu-

lation using island biogeography theory indicates that with forest down to 86% of what it used to be, about 4. 5% of species may have been lost.

3. 7. Information on previous studies

Studies carried out relating to biodiversity and allied subjects by various organizations are listed below:

3. 7. 1. ANET

- Distribution and biogeography of herpetofauna of the ANI.
- Protected Area Management Planning.
- Ecology, behaviour and demography of the Andaman day gecko
- Terrestrial behaviour and geographical variation in the Yellow lipped sea krait in Andamans.
- Distribution & biogeography of reptiles and amphibians in the ANI.
- Sea turtle status surveys, studies and their conservation ANI.
- Ecology, status and conservation of salt-water crocodiles in ANI
- Utilization patterns of forest produce at Wandoor Village.
- Ecological appraisals of RJMP, Mt. Harriet NP, Little Andaman Island
- Botanical appraisals of RJMP, Mt. Harriet NP, Saddle Peak NP, MGMNP & Wandoor
- Socio-economic studies of MGMNP, RJMNP, Saddle Peak NP and Mt. Harriet NP
- Impact of elephants on island ecosystems
- Tourism assessments South Andaman Island
- Wetlands assessment of Andamans, Little Andaman and Great Nicobar Islands.
- Water management at Wandoor Village.
- Census and impact of feral elephants on Interview Island.
- Impact of spotted deer on natural regeneration of small island ecosystems- MGMNP.

- Shark fin harvest in the Andaman Islands.
- Ecology and status of bats of ANI.
- Ecology of the Great Nicobar tree shrew.
- Impact assessments around Little Andaman Island and the Jarawa Reserve.
- Impact assessment of the 2004 quake and tsunami.

3. 7. 2. BNHS

- Inventory and distribution of birds & bats in ANI.
- Important Bird Areas ANI.

3. 7. 3. BSI

- Preparation of flora of the ANI.
- Enumeration of area wise distribution & species analysis of mangrove vegetation
- Study on wild relatives of crop plants of ANI.
- Study on wild ornamental plants of ANI.
- Establishment of botanical gardens at Dhanikari and Kalpong.
- Establishment of a orchidarium and a Fern house
- Studies on economical important plants and wild edible fruits

3. 7. 4. CARI

- Ecological considerations and agricultural development of ANI
- Insects of agricultural importance in ANI.
- Rice based cropping system for Bay Islands.
- Plantation based cropping system for Bay Islands.
- Exotic flora and fauna in ANI.
- Fodder resources of Bay Islands.
- Corals of ANI - a status report.
- Under utilized tropical fruits of Bay Islands.
- Indigenous poultry germplasm of ANI.
- Feral goat: Unique germplasm of Barren Islands.

- Unicellular algae in ANI.
- Anemone fishes in ANI.
- Butterflies of ANI

3. 7. 5. CAS in Marine Biology

- Marine resources of Great Nicobar Island.

3. 7. 6. Delhi University

- Ecosystem dynamics and plant-animal interactions in the Great Nicobar Biosphere Reserve.

3. 7. 7. Dept. of Space (IIRS, ISRO, NRSA, VSSAC), Govt. of India.

- Characterization of biodiversity at landscape level
- Development of a GIS based information system on natural resources.

3. 7. 8. AN DE & F

- Flora of Andamans
- Forest regeneration
- Forest utilization
- Regeneration of padauk
- Teak plantations
- Mangrove area management
- Timber properties
- Working Plans
- Management plans of MGMNP and Mt. Harriet NP.
- Status of corals in ANI.
- Phenology & nursery behaviour of flora
- Introduction trials of exotics
- Plantation trials of native species
- Growth and increment studies of native species
- Survey of grasses
- Forest statistics
- ANI forest & environment

3. 7. 9. Fishery Survey of India

- Fisheries potential of ANI.
- Socio economics of fishermen

3. 7. 10. FSI

- State of forest reports.
- Pre-investment surveys
- Report on forest regeneration in the ANI.

3. 7. 11. ICFRE

- Revision of Parkinson's flora
- Planting stock improvement (Establishment of SPAs/ Seed orchards)

3. 7. 12. IIPA

- Directory of national parks and wildlife sanctuaries for the A & N.

3. 7.13. JNRM

- Butterflies
- Mangroves

3. 7. 14. KFRI

- Studies on rattans (canes)

3. 7. 15. NAEB (RC) at Jadavpur University

- Eco-tourism
- Utilization of minor forest produce
- Regeneration survey

3. 7. 16. NBRI

- Medicinal Plants- inventories

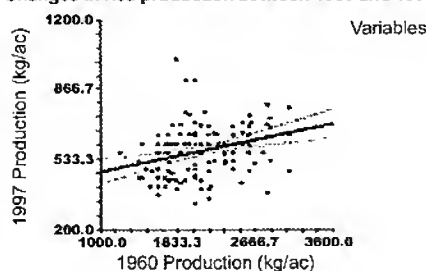
3. 7. 17. Pondicherry University

- Impact of Andaman shelterwood system
- Birds of MGMNP
- Bird survey of selected islands in the Andamans
- Butterfly survey of selected islands in the Andamans
- Ecology and behaviour of Nicobar macaques
- Forest tree diversity of moist evergreen forest in Andamans.

Box 2. ANET's rice yield study in the North and South Andaman Islands

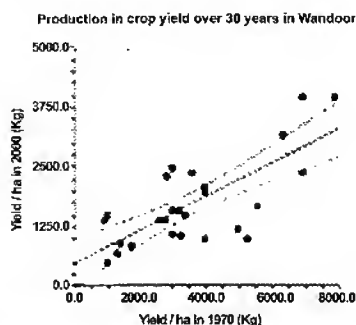
Rice yield decline in North Andaman Island: A study, conducted in 1999, shows that productivity of rice has declined from what it was 40 years ago: from 5.24 tonnes/ha to 1.57 tonnes/ha, suggesting that converted rainforest soils cannot sustain rice farming for long periods (Ali, 2000). However, Dept. of Agriculture statistics show that rice production is now 2.68 tonnes/ha. In North Andaman they have no figures for past production. It is stated that rice production in North Andaman has in fact increased as there was a shift from cultivation of C-14-8 to high yielding varieties of rice and more areas were brought under HYVs. The two methods need to be reconciled. However, rice yields have declined and rice farming needs to be phased out because of this. Alternative land uses include agro forestry, involving a mix of vanilla, bamboo, rattan and timber species.

Changes in rice production between 1960 and 1997



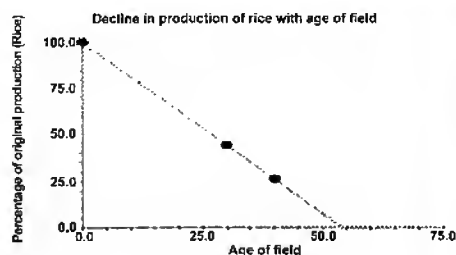
Rice yield decline in South Andaman: A study at Wandoor and Manjeri comparing the current production with that of 30 years ago has shown that the yield has dropped from 3.80 tonnes/ha in 1970 to

1.80 tonnes/ha now (Singh, et al., 2002). A comparison between the Wandoor and the Saddle Peak data indicates that, if the current trends continue, rice production is projected to drop to zero by the year 2015 at Saddle Peak. Whatever yield there is likely to be will be due to massive inputs of fertilisers.



Model Estimation Section

Parameter	Parameter	Asymptotic	Lower	Upper
Name	Estimate	Standard Error	95% C.L.	95% C.L.
A	0.4422972	2.721302E-02	0.3866403	0.497954



By the year 2015 the yields in North Andaman will have declined to nothing if the current trends continue!

- Vascular epiphytes in South Andaman Island

3. 7. 18. SACON

- Ecology, distribution and conservation of the Nicobar megapode
- Ecology, distribution and conservation of the Andaman teal
- Ecology, distribution and conservation of the Andaman crake
- Status and conservation of the Narcondam hornbill
- Census and impact of feral elephants on Interview Island.
- Conservation and ex-situ farming of the edible-nest swiftlet.
- Ecology of the edible-nest swiftlet.
- Impact assessment of the 2004 quake and tsunami.

3. 7. 19. WII

- Survey of coral diversity & land use in the MGMNP

3. 7. 20. WWF-India

- Biodiversity characterization and conservation Project.
- Prioritizing sites for biodiversity conservation

3. 7. 21. ZSI

- Mangrove fauna
- Reef fishes of ANI.
- Fish families Siganidae and Acanthuridae
- Commercial fish families Caesiariidae and Mullidae
- Echinodermata of Nicobars
- Study of coral reefs

3. 8. Information on previous surveys

- Birds- ANI (BNHS & SACON)
- Birds- selected Andaman Islands (Pondicherry University)

- Butterflies ANI (JNRM, Pondicherry University & ZSI)
- Butterflies-selected Andaman Islands (Pondicherry University & CARI)
- Bats- ANI (ANET)
- Coral reefs (AN DE & F, WII, CARI & ZSI)
- Fishes of ANI (ZSI, CARI & ANET)
- Forest surveys (AN DE & F, FSI & IC-FRE)
- Fresh water fishes - Andamans (ANET)
- Herpetofauna ANI (ANET & ZSI)
- Floristic survey of grasses (AN DE & F and BSI)
- Herpetofauna- ANI & Great Nicobar Biosphere Reserve (ANET)
- Floristic Survey of Great Nicobar Biosphere Reserve (BSI)
- Floristic Survey of Saddle Peak National Park Area (BSI & ANET)
- Floristic Survey of Mount Harriet National Park (BSI & ANET)
- Floristic Survey of MGMNP (BSI & ANET)
- Floristic Survey of RJMNP (BSI & ANET)
- Floristic Survey of Kalpong Hydro-Electric Project Area (BSI)
- Floristic Survey of Grasslands of Nancowry Islands (BSI)
- Floristic Survey of Barren Islands (BSI)
- Floristic Survey of Reserve Forests of Shompen & the Jarawa Reserves (BSI)
- Mariculture potential of ANI - an indicative survey. (CARI)
- Medicinal plants (AN DE & F, NBRI, BSI, ANET & CARI)
- Mangroves (JNRM)
- Marine Turtles ANI (ANET)
- Socio economic status of fishermen in Andamans. (Fisheries Dept, CARI & ANET)
- Socio economic survey of MGMNP, SPNP, MHNP & RJMNP (ANET & WII)
- Saltwater crocodiles ANI (ANET)
- Survey of fungi (AN DE & F and FRI)

4. Current range and status of biodiversity

4.1. State of forest ecosystems

Till 1870 there were no records of commercial exploitation of forest products. Irregular and selective felling remained confined to commercially important species. Rapid forest activities started after Independence and a number of industries based on timber came up. One of the most productive systems exists here and has trees (592 sp.) shrubs (320 sp.), climbers (175 sp.) and herbs (491 sp.). 16.18% of the forest area is under tribal reserve, 13.57% are mangrove and 7.4% are managed under national parks and sanctuaries. In total 69.58% of the forest area (4989.90 km²) is protected in the form of tribal reserves, national parks and sanctuaries, and further in the form of mangrove conservation working circle and protection working circle even within the area covered by working plans. 30.41% of the forest area (2180.79 km²) was set aside for forestry operations and till 2002 only 15.49% of the forest area (1110.52 km²) had been regenerated under the Andaman Canopy Lifting System. The future operation for timber extraction, solely for meeting the local requirements, shall remain confined to this area of 1110.52 km² already extracted and regenerated, in terms of the recent order of the Supreme Court. The rest of the forest area will come under protection.

Some important forest species include:

Dipterocarpus alatus, *D. grandiflora*, *D. pilosus*, *D. costatus*, *Artocarpus chaplasha*, *A. gomeziana*, *Calophyllum soularti*, *Amoora wallichii*, *Pterocymbium tinctorium*, *Gnetum scandens*, *Sideroxylon longipetiolatum*, *Croton argyratus*, *Mesua ferrea*, *Canarium manii*, *Euphorbia trigona*, *Pterygota alata*, *Dillenia pentagyna*, *Clerodendron viscosum*, *Cerios tagul*, *Diospyros marmorata*, *Ventilago sp.* *Acacia sp.*, *Manilkara littoralis*, *Morinda citrifolia*, *Erythrina variegata*, *Calophyllum innophyllum*, *Thespesia populnea*, *Hibiscus tiliaceus*, *Crimum asiaticum*, *Vigna retus*, *Colubrina asiatica*, *Caesalpinia bonducella*, shrubby growths, canes, surface creepers and bamboo.

Economically important species include:

Pterocarpus dalbergioides, *Sageraea elliptica*, *Diospyros marmorata*, *Murraya exotica*, *Terminalia bialata*, *Terminalia procera*, *Terminalia manii*, *Mudhuca butyracea*, *Pajanelia rheedii*, *Albizia lebbek*, *Artocarpus gomeziana*, *Planchonia andamanica*, *Calophyllum inophyllum*, *Lagerstroemia hypoleuca*, *Parishia insignis*, *Artocarpus chaplasha*, *Hopea odorata*, *Adenanthera pavonina*, *Dipterocarpus spp.*, bamboos and canes.

The islands are at a critical juncture, and any further disturbance, whether due to immigration and encroachment, over-fishing or logging, is likely to have serious effects in terms of the loss of biological diversity. Since island ecosystems are small, fragile and unique unlike continental ecosystems, the problem of very restricted distribution for some species comes in. This, together with the presence of endemics, is central to biodiversity conservation in an island ecosystem. Management systems are required to be more conservation oriented for the long-term protection of many such species.

One of the main used forest ecosystems is the removal of non-timber forest produce (NTFP). NTFP in the islands, which are commonly used and being collected at present, include:

- Canes - suitable for walking sticks, basket making and furniture;
- Honey - available from the forest as an important source of food for the tribals.
- Bamboo - plays a major role in construction, fencing, baskets and mats in rural areas
- Poles - used as a construction material
- Fuel Wood - the main source of fuel in most rural areas
- Edible tubers form a major part of tribal diet

Besides above, there are other NTFP like gums and resins, fruits/ seeds, etc., which may serve as a potential source of NTFP after their proper studies and surveys/ assessment about availability are made. However, due to ecological considerations, the collection of fruits and seeds is not permitted and these forests are allowed to naturally regenerate.

Forests are down to 84% of what they used to be, and probably another 10-20% is affected by human activity. This could lead to a long-term reduction of between 4.5-13% of the islands terrestrial endemic fauna and flora (This is derived by using $Z=0.301$ in applying the MacArthur & Wilson theory of island biogeography) (MacArthur & Wilson, 1967).

4. 2. State of agricultural ecosystems

The land that was brought under agriculture by 1981 was 14,953 ha and by end of 1992 the land under rice was 12,000 ha. Currently it is over 53,315 ha and of this 27,890 ha are under coconut and areca nut plantations. This area is decreasing due to urbanisation, industrialisation and the intrusion of seawater. Socio-economic surveys conducted around two national parks show that only 41% of villagers raise paddy and plantation crops and 54% raise plantation crops alone (Singh, 1997; Ali 2000).

Agricultural ecosystems have been adapted almost in toto from mainland India. Very few indigenous varieties are used and only a little germplasm of different crops is available here. Wild rice species have been reported from Saddle Peak area and Rutland Island (Ellis, 1987a; b). The islands also fall within the geographical distribution of coconuts and wild germplasm may be available here. On the whole, loss of agricultural diversity will not be a serious issue here. The exception to this is the necessity for an effort to identify more wild relatives of cultivars.

According to estimates concluded by the Food and Agriculture Organisation of the UN, ANI can support three persons/ha. at an intermediate level of agriculture and five persons/ha. at a level of intensive and technologically advanced agriculture. The 1989 production rate is not a significant increase since then, the Andamans can only support 1.6 persons/ha. Current increase in population trends, clearly indicate that the agriculture carrying capacity has been well surpassed (Sirus, 1999; Andrews & Sankaran, 2002).

However, a decline in rice yields has been found in two areas in North and South Andaman

Islands and there is a surplus of locally grown rice in the Andamans (Box: 2). Fungal infestation at the harvest and post harvest yields has made rice farming unremunerative in a number of areas. Farmers do not, at the moment, want to phase out this cultivation because it is used for personal consumption and in exchange for labour. The quality is sub standard and FCI will not procure it and most people in the islands prefer purchasing rice imported from Chennai, which indicates that the standard of living has gone up. The decline in yields is likely to result in considerable pressure on the surrounding forests and seas, and this has consequences for the richness of these forests, marine resources and coral reefs.

Due to better opportunities and alternative source of income in the forestry, business and fishery sectors relatively few people are engaged in agriculture (16% in cultivation and 4% as agricultural labourers). In fact for a lot of people agriculture in the islands is treated as a secondary enterprise. Minor irrigation is still scarce in Andamans. By digging ponds and collecting rainwater for dry season crops (for which government assistance is available) an area of 952 ha has been brought under the minor irrigation scheme.

Fertilizer used by the farmers (approx. 5 kg/a. or less) is causing low crop productivity. The use of pesticides and chemical fertilisers is, however, resulting in damage to the ecosystems here and there is paucity of data from the islands. The consumption of pesticides, though on the rise is constrained by the heavy rainfall that results in higher applications being necessary. It is also constrained by lack of availability. However pesticide usage is high in Diglipur area in North Andaman Island, Middle, South, Little Andaman, Neil and Havelock Islands, around where some of the best mangroves, fresh water streams and coral reefs occur.

4. 3. State of marine ecosystems

The ANI coastline is 1,962 km and around 35,000 km² of continental shelf that provides potential fishing grounds. The 200 miles of Exclusive Economic Zone (EEZ), around A & N

group of islands, is vast and covers a sea area of 0.6 million km², which is about 30% of the EEZ of India. The Census of India (1991) estimated the fisheries potential as 160,000 tonnes of which 100,000 tonnes as tuna and tuna-like fishes. Reports by CARI show that out of the total 130,000 tonnes of pelagic stock, only 13,200 tonnes are currently exploited (Soundararajan, unpub.). The Fisheries Department has reported that the fisheries potential is 1,48,000 tonnes and the current total catch is 28,000 tonnes. Currently there are 2,721 fishermen who ply around 1,810 boats around ANI (Sirus, 1999; Fisheries report, 2001; Andrews & Sankaran, 2000; John et al., 2005; Singh & Andrews, 2003).

The ANI did not have any fishing community and the fisheries sector began by bringing fishermen families from the mainland and settling them on the islands. The Department of Fisheries was set up by the ANI Administration in the islands in 1955. Since then fishermen from Kerala and Andhra Pradesh were settled in the islands. The ANI Administration provided these people with land, housing, loans and fishing equipment. CARI and the Fisheries Department are also trying to develop inland aquaculture.

Efforts have been made by the ANI Administration to promote the growth of commercial fishing, storage, marketing and exports. They have set up the ANI Integrated Development Corporation (ANIIDCO). ANIIDCO has floated a company, the Andaman Fisheries Limited (AFL). AFL has set up cold storage and processing plants. The Marine Products Export Development Authority funded by DOD is also in the process of implementing a demonstration project for prawn farming. However there is a lack of co-operatives of self-help groups among fishing communities and the settlers (Sirus, 1999; Singh et al., 2002; Singh & Andrews, 2003).

The Bay islands enjoy the status of an archipelago and geographically they are close to Indo-Malayan region, which is supposed to have contributed as a faunistic centre to the recruitment of fauna in the regions of Indo-West Pacific. Because of limited studies on marine fauna of the ANI, the nature of their evolu-

tion as isolated populations are little known. Nevertheless, it has been clear from the available literature that many marine fauna of these islands are similar to those of Indo-west Pacific.

4.3.1. Fish

The area available for fisheries around the Andamans is 16,000 km². The fisheries potential is estimated at 1,48,000 tonnes, as against a current (official) catch of 28,000 tonnes. 17% of this is estimated to come from coral reef areas. The vast potential can be envisaged from the following facts that 1/3 of EEZ of our country lies around Andaman and Nicobar Islands and 1/4 of total coastal area of our country also belongs to ANI. Shark, sardine, mackerel, trevelly, catfish, mullet, ribbonfish, barracuda, grouper, snapper, scor fish and tuna form important fish groups in commercial fishery. Recently certain heavily exploited and endangered marine fishes have been accorded protection under the WLP, 1972 such as Whale Shark, Giant Grouper, Sawfish and six other species of sharks.

More than 1150 fish species in 507 genera and of 151 families have been recorded from the seas around ANI. These species occur in coastal waters, offshore, brackish water and in freshwater systems (Davi & Rao, 2003a; 2003b; Rajan, 2001; 2003; Rajan, et al., 1993; Rao, 2004; Rao, & Devi, 2003; Rao, & Devi, 2004; Rao et al., 2000), (Appendix 9).

4.3.2. Reefs

ANI are fringed by one of the most spectacular and extensive reefs in the world and currently they are not only significant for the Indian Ocean region but is also globally significant (Kulkarni, 2000; Vousden, 2001; Turner et al., 2001; Andrews & Sankaran, 2002). However, the extent of reefs in the ANIs not accurately known yet. Spare Applications Centre, Ahmedabad reported 744.70 km² as the coral reef area (SAC, 1998). Recent surveys report the extent as 11,939 km² (Turner et al., 2001). Pillai (1972) reported 68 species belonging to 31 genera and the same author in 1983 report-

cd 135 species for both island groups. Wafar (1992) also identified 135 species in 59 genera and the same author in 1996 calculated the reef extent for A & N as 11,000 km², Qasim (1998) reported 189 species for ANI. Outside of MGMNP, very few studies have been done previously. A survey conducted by ZSI in collaboration with UNDP reported 197 species of corals within 58 genera with an average of 65 species at the 13 different sites sampled (Vousden, 2001; Turner et al., 2001). They also reported the extent as 11,939 km² that includes lagoons, banks, reef slopes and reefs. The total area of reef flat was estimated to be 259 km², providing a total area of shallow reef of 520 km² around North Andamans alone. Species numbers ranged from 44- 89 and averaged 65 species per site. These same authors have reported that the Andaman reefs consist of about 83% of maximum coral diversity found anywhere in the world and is equal to the 'Coral Triangle' off Indonesia. They estimate about 400 species could emerge after further surveys. However, over 250 species have been reported by Kulkarni (2001; 2002), Turner et al (2001) (Appendix 10).

There are two protected areas for reefs in the Andamans, the MGMNP and the RJMP and both have adjoining reefs that need inclusion. There are also large areas of reef outside these PA's that are largely ignored, with very little protection efforts going into them. A study of the marine fauna in the MGMNP, Wandoor, and South Andaman was conducted by a project sponsored by the Science and Technology Department of A & N Administration. During this survey 115 coral species were recorded within this NP alone, which included new records for the islands (Kulkarni, 2000). The same author on a follow up survey around Andamans reported 189 species with, again, several new records for the islands (Kulkarni, 2001; 2002).

ANI have the last pristine reefs in the Indian Ocean region, and are emerging as one of the most important coral reef sites in the world. Currently reefs have become globally threatened due to various environmental and climatic factors along with greater use of their resources both directly such as over fishing

and indirectly through recreational tourism. All scleractinian corals and some associated reef fauna such as sea cucumbers and giant grouper have been brought under the purview of the WLPA, 1972 under Schedule I. Nine species of molluscs have also been placed in various Schedules of WLPA, 1972.

The 2004 M 9.0 earthquake and the subsequent tectonic plate shifts caused extensive upheaval of reefs in Andamans, which are now dead reef flats. The high intensity force of the tsunami and the subsidence of the islands in the Nicobars and south Andamans, have destroyed coral reefs to very great extent. The extent and current status has been reported (Andrews & Vaughan, 2005; Ramachandran, 2005; Sankaran, 2005).

4. 3. 3. Crustaceans

Two groups of crustaceans namely, microcrustacea and macrocrustacea exist. The former includes copepods, ostracods, and cladocerans. The latter include lobsters, crabs and prawns. More than 400 species of crustaceans have been recorded which include 14 species of barnacles (sub class: Cirripedia); 146 species of prawns, shrimps and allied forms (sub class: Malacostraca; order: Decapoda; suborder: Ntantia); 217 species of crabs and allied forms (suborder: Reptantia), 7 species of lobsters and 37 species of mantis shrimps (order: Stomatopoda),

Among lobsters, seven species have been known: *Panulirus* spp. (six) and one *Linuparus* sp. The most common species are *Panulirus versicolor* and *P. longopes*. *P. penicollatus* and *P. ornatus* occur in deeper waters. *Linuparus* sp. has been found as an important lobster resource in trawl catches along the east coast of the Andamans. The deep-sea lobster *Purulus sewelli* is also an important exportable lobster resource, caught off Andamans; both along the east and west coasts and being exported to Malaysia and Singapore.

4. 3. 4. Molluscs

These constitute a very large group as sea-shells and they exhibit diversity in shape, size,

colour and form. The Gastropoda have single shells, many of which have high commercial value because of their beautiful colouration and shape. The bivalves have two shells and many of them serve as edible seafood. The nudibranchs have no shell and have little economic importance. The Cephalopods are fast swimming molluscs such as squids and octopi, and have a high commercial value. There are primitive molluscs like Chiton that live adhering to inter-tidal rocks.

4. 3. 5. Gastropods

Some of the important gastropods which are rare on the mainland coast are top shell (*Trochus*), turban shell (*Turbo*), king shell (*Cassia comuta*) and queen shell (*Cyprecasis rufa*).

Pearl oysters have very high commercial value as they produce pearls. Five species have been known and among them blacklip pearl oyster, *Pinctada margaritifera* is predominant. The pearl culture technique for this species is yet to be developed in India. The most used species in India is *P. fucata* and it is rare in these islands. The very highly valued large pearl oyster species, *P. maxima* is presumed to occur in these islands, even though it has not been authentically collected from Andaman waters so far.

4. 3. 6. Giant clams

Four species are known to occur and among them *Tridacna crocea* is most abundant. *T. maxima* has commercial value. The other two species *T. squamosa* and *Hippopus hippopus* are rare. *Tridacna maxima* and *T. squamosa* which grow very large (a few hundred kg in weight), can be cultured. Current threatened species of sharks, rays and molluscs are shown in Appendix. 11.

4. 3. 7. Sea grasses

Of the 14 species known from the Indian seas, nine have been reported from around the Andaman and Nicobar Islands. Just around RJM-NP eight and seven species have been reported around two islands and meadow sizes ranging

from 0. 3-3 km long and accounting for 80% sea grass cover, where as it is only 67-76 % for the rest of the Andamans. After the 2004 tsunami damage to meadows, to an extent, in the Nicobars has been report by Sankaren (2005). Species richness for several areas and extent of meadows has also been reported (Das, 1996) (Appendix 12).

4. 4. State of mangrove and coastal ecosystems

The estimated area of mangroves in 1957 in the islands was about 105, 694, 116, 640, 117, 100 hectares (Mathunda, 1967; Wahcedkhan, 1957; Sahni, 1957). Another estimate done in 1986/1987 using LANSAT imagery estimated a total of 777 km² for ANI of which 287 km² is for the Nicobars. Another estimate indicated 1012 km² as the extent (Balakrishnan, 1989). The 1999 estimate by FSI was 966 km². Their recent estimate in 2003 is 644 km² in Andaman and 27 km² in Nicobars (FSI, 2003). Dagar (1982) Mall et al (1982) have reported on the ecology, and Debnath (2004) has discussed the extent and distribution in ANI. It is known that mangroves form the feeding grounds for commercially important finfish's and crustaceans. Mangrove areas are also known for their diversity of various marine organisms.

ANI mangroves have 253 species of fish, 410 species of polychaetes, and 53 species of meiofauna associated with them. It is clear that any degradation of coastal ecosystems such as coral reefs and mangroves will have an adverse impact not only on the unique biodiversity of fragile coastal ecosystems but also on coastal fisheries and tourism, which is becoming the mainstay of the island's economy.

There are 58 mangrove species found in the islands. These include *Rhizophora mucronata*, *R. candelaria*, *Bruguiera conjugata*, *B. parviflora*, *Avicennia*, *Xylocarpus* sp., *Ceriops tagal*, *Sonneratia* sp., *Lumnitzera* sp. *Kandelia kandel*, and *Acanthus ilicifolius* (Balachandra, 1998; Dagar et al, 1991; Dagar & Dagar, 1999; Debnath, 2004) (Appendix 13).

Dagar and Sharma (1989) have reported on the impacts of development in the Andamans,

on mangroves and Singh et al (1990) on human impacts.

4. 5. State of wetland ecosystems

Freshwater wetland ecosystems of the islands have at least two restricted range endemic bird species: Andaman crake and Andaman teal (Andrews & Whitaker, 1994a; Vijayan, 1996a; b; Vijayan & Sankaran, 2000), besides being very important nesting habitat for the saltwater crocodile and feeding areas for bat species. Swampy areas in lowland evergreen forests have been almost totally destroyed by conversion to agriculture and land fills, with the only substantial tracts remaining in Baratang and Little Andaman Islands, and the Jarawa Reserve off the west coast of South and Middle Andamans (Andrews & Whitaker, 1994a; Andrews, 1999; 2000 b; 2000 c; 2001; 2002). Little Andaman Island has wetland ecosystems found nowhere else in the ANI. These include long stretches of freshwater streams, open saline marshes, peat bogs and large tracts of freshwater grassy marshes (Andrews, 2000 b; Andrews & Sankaran, 2002).

Open swamps have also been drained in a number of places, making this an increasingly rare habitat. Demarcating and protecting these becomes a priority task. There are also significant wetlands in revenue areas that need protection. Areas exist in Chouldhari, Bamboo Flat, Sippighat, Wandoor, Baratang, Mayabunder and North Andaman Island.

There are no large rivers in ANI however the ANI is interlaced with several freshwater streams and most of these drain into a mosaic of mangrove creeks and these are listed in Appendix 14. These streams and creeks are very important ecosystems and are habitats for some of the mega species, the Andaman teal, Andaman crake, several freshwater fish species not recorded before and new to science, roosting habitat for fruit bats, nesting habitat for the Andaman crested serpent eagle, saltwater crocodiles inhabit the mangrove creeks and marshes, and females crocodiles use the banks of freshwater streams for nesting and hatchlings and juveniles crocodiles inhabit the freshwater streams (Andrews & Whitaker,

1994a; b; Vijayan, 1996a; Andrews, 1999; 2002; Andrews & Sankaran; 2002; Ali et al., 2002; Aul; 2003). The impacts and pressures have been previously discussed (Dagar & Sharma, 1989; Singh et al., 1990; Andrews & Whitaker, 1994; Vijayan, 1996a; Andrews & Sankaran, 2002).

After the 2004 tsunami and the subsidence of South Andaman Island, most the areas are inundated by sea water. In Great Nicobar Island most of the inland wetlands on the south eastern and south western sides are affected to a great extent and is being inundated by sea water, including islands in the middle Nicobar group (Chandi, 2005 (*Unpub*); Andrews & Vaughan, 2005; Sankaren, 2005).

4. 6. State of introduced and domesticated livestock

Cattle: Two different genetic groups of cattle are found here, namely local cattle of Andaman and Trinkat. Local cattle of Andaman are distributed in Andaman group and in Campbell Bay. These populations consist of three breeds: Sahiwal, Haryana and Red Sindhi. Trinkat cattle are concentrated in Trinkat Islands only, probably introduced by the Dutch.

Goat: There are three genetic groups of this species: the now local goat of Andaman (Black Bengal type), Teresa goat and the feral goat of Barren and Narcondam Island. A small population of Malabari goat is also available with the AH & VS.

Buffalo: Buffaloes were introduced from mainland India and these are distributed in the Andaman group of Islands and Campbell Bay.

Pig: There are three different genetic groups of pigs in the Islands; however their systematics is currently unknown. They are the local Andaman wild pig, long snouted Little Andaman wild pig and the Nicobar wild pig. Andaman wild pig was once found all over in the forests of the Andaman group, but have become rare and currently the last strong holds are the Jarawa Reserve, Rutland and Little Andaman Islands. Nicobar wild pig is concentrated in Nicobar group of Islands.

Hybrids from mainland India have been domesticated and some of these have been hybridised with the indigenous varieties in the Nicobars and in Mayabunder area (Andrews, pers. obs.).

Poultry: Includes chicken, duck, guinea fowl and quail (recently introduced by CARI). The different breeds of fowl include the Nicobari fowl, an endemic that has become extinct and pure strains cannot be found any more and CARI has developed a hybrid of this species, without maintaining the genetic stock. Others include naked neck, frizzle fowl, barred desi and aseel. Ducks include mainland Indian domestic species, Khaki Campbell and their crosses.

Due to the 2004 quake and tsunami on Great Nicobar Island, domestic animals have become feral, and these include pigs, goats, cattle, dogs, cats and chickens and this is of major ecological significance and needs to be addressed. (Andrews & Vaughan, 2005).

4. 7. The 2004 earthquake and the tsunami

The December 2004 *M* 9.0 earthquake and the subsequent tsunami caused immense ecological changes to both island groups, including taking a toll on human life, human life patterns for indigenous groups in the Nicobars, infrastructure, and permanent change to agricultural lands and plantations. The quake and tectonic plate shifts resulted in upheaval of most Andaman Islands including Little Andaman Island, causing upliftment of reef flats, drying of mangrove creeks, drying of

mangrove strands and shifting of strands into creeks.

The subsidence of the southern South Andaman Island and the Nicobars have caused major impacts on coastal ecosystems, fauna, flora and freshwater systems, besides most marine turtle nesting beaches have been washed away. The impacts, ecological changes, implications and recommendations have been discussed by several authors (Andrews & Vaughan, 2005; Chadha, 2005; Banerjee, 2005; Ramachandran et al., 2005; Ramana-murthy et al., 2005; Sankaran, (2005); Malik & Murty, 2005); Mishra & Rajasekhar, (2005); Nath et al., (2005).

5. Statement of key issues and problems

5. 1. Loss of forest cover and conversion to monoculture

5. 1. 1. Status of forest cover

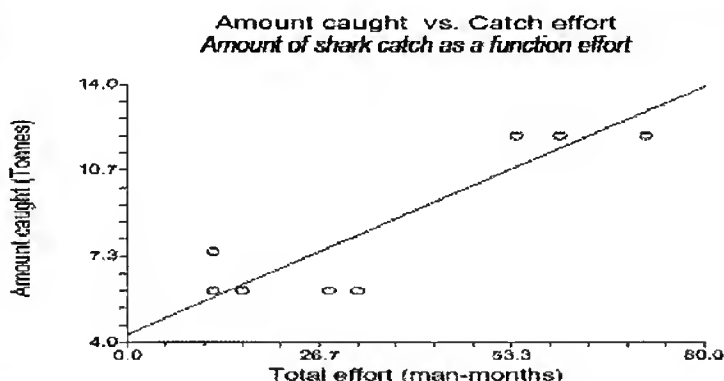
Although the total forest cover of the islands is still around 84% (according to FSI), there has been a continuous decline in forest cover over successive assessments in 1990's by FSI. The extent of forest cover reported over different assessments between 1987 and 1999 are: 1987-7601 km²; 1989-7622 km²; 1991-7622 km²; 1993-7624 km²; 1995-7615 km²; 1997-7613 km² and 1999-7606 km². The 2001 assessment has shown a forest cover of 6930 km², but the decline is mainly due to change in the scale of satellite data interpreted from

Box 3. Summary statistics of individual boat catch rate and seasons of crustacea

Taxon	No. of persons / boat	Monthly catch (kg)	Price: Rs/kg	Season length (months)	Sample size
Crabs	3	42 (10-150)	210 (Red) 20 (Green)	5	36
Lobsters	4.7	97.5 (10-350)	300	11	6
Shrimp	4.1	180 (20-450)	70	5.33	20

Source: ANIET 2001 (Unpublished).

Box 4. ANET case study- Catch effort required to catch sharks



Source: ANET 2001 (Unpublished).

1:1,25,000 to 1:50,000 and method of interpretation from visual to digital. However, the 2003 assessment shows an increase to 6964 km² of forest cover.

5. 1. 2. Impacts of encroachment

Encroachment remains the major problem affecting the forest cover. Encroachment problem is linked to the increase in the number of families originally settled in the islands due to expansion and also uncontrolled immigration into the islands. Encroachments lead to forest fragmentation, reduction in forest cover, and its conversion to monocultures leading to loss of biodiversity. Encroachments also lead to degradation of the forests near them due to illegal collection of forest resources. Each encroachment pocket became a nucleus for further encroachments and degradation of adjacent forest areas.

5. 1. 3. NTFP extraction

An important aspect of NTFP extraction is that all bonafide agriculturists in possession of agricultural land residing outside municipal area used to be issued NTFP, viz., two cords of

firewood, 500 bamboos, 100 ballies, 20 posts, 2000 thatching leaves and 200 canes per year on collection of a permit fee of Rs.5., but free of royalty, for personal use. This is generally misused, and the NTFP collected is sold for commercial use. Though permission is given only for collection of non-commercial ballies and posts, it is difficult to verify the species of each material collected, and there is a possibility of collection of commercial ballies and posts which may affect the regeneration of those species adversely. Further, removal of the young regeneration, in the form of ballies and posts is likely to affect the condition of the future forest. However, now on the recommendation of Shekhar Singh Commission accepted by the Supreme Court, the grant of NTFP free of royalty has been discontinued.

5. 1. 4. Forests in privately held lands

Settlers have been allotted hilly lands for horticulture. They were permitted to extract and sell the timber on these lands, on payment of royalty to the Government, if the Department of Environment and Forests was unable to clear the area for horticulture. Since they do not have the infrastructure to do this, middle-

men do it for them. In the process the land is cleared and erosion takes place. Such lands under normal circumstances are to be converted into horticulture, usually for the cultivation of areca nut, coconut or spices, but in certain cases they have not been converted so far and are lying fallow and eroded. There are also large tracts of allotted land covered by forest growth. As per the Hon'ble Supreme Court ruling, all such areas come under the definition of 'forest' for the purpose of Forest (Conservation) Act, 1980. These areas need to be dealt with accordingly.

5. 1. 5. Timber extraction and its impact on biodiversity

There are no detailed vegetation maps of the past to compare with the present for the islands. As a consequence, the extent to which particular vegetation types are affected by timber operations is not known. How much of the vegetation type is affected by the land relief is yet to be determined. The extent of vegetation of various types currently present on flat land is provided in the Table-1. Recently in Thailand, the Gurney's Pitta (*Pitta gurneyi*), thought to be extinct, was found in the last remnant patch of lowland forest. It is, therefore, prudent to protect these patches until proper surveys are conducted.

Table 1. Vegetated area by forest type on flat lands.

Vegetation Type	Area on Flat Land (Km ²)	Total Area (Km ²)	% in this topography
Evergreen	27.06	672.13	4.02
Semi-Evergreen	92.80	1514.68	6.13
Moist deciduous	155.39	3148.83	4.93

Source: FSI, 2001.

A regeneration survey conducted by FSI has revealed that though the regeneration status is satisfactory, change in stocking under the present management practices indicates decline in ornamental and softwood species in some forest divisions and fall in ply species in some localities. The study has recommended a conservative approach in exploitation sched-

ule and improving future crop by adequate regeneration of desired species compatible to ecosystem needs (Elkunchwar et al., 1997).

A specific problem, which also affects regeneration in worked areas, is due to the presence of spotted deer (*Axis axis*) in these islands. Deer browse on seedlings and therefore have affected natural regeneration in timber extraction areas to a great extent. Species not browsed on include *Planchonia andamanica*, *Nauclea gaganea*, and *Lagerstroemia hypoleuca*, and these have become abundant in natural regeneration areas. Similarly, gaps in littoral forests are dominated by *Derris indica*. The effect of such grazing on forest has been well documented from other places overseas (Struhsaker, 1997).

Another issue that has cropped up with timber extraction is the loss of orchids. A study by Gopal (1991) reports 107 species, a very heavy epiphyte load on most forest trees in South Andaman Island and these are lost during forestry operations. A study conducted by Pandit (1991) shows that the Andaman Canopy Lifting Shelterwood system leads to a change in the species composition and diversity. While forest management system developed for the island over last 100 years to get a crop that is commercially more valuable, its implications for biodiversity conservation need to be analyzed in greater detail. These impacts are localized to about 15% of the forest area.

5. 1. 6. Damage to watersheds

Most areas in the islands, especially urban areas, suffer from a drinking water shortage in the months of March and April, in spite of the annual rainfall being almost 3500 mm. The geology of the islands does not permit ground water storage. The role of surface storage systems therefore becomes extremely important. For this, it is important that vegetation cover in the catchment areas for each watershed should be protected as much as possible. Encroachments in many rural areas have led to the degradation of these watersheds and has resulted in accentuating the drinking water problem.

5. 2. Decreasing agricultural productivity

5. 2. 1. General

The Andaman ecosystem is not suitable for agriculture and horticulture. If current agricultural practices continue these islands will always be a net economic liability on the rest of India. Studies conducted by ANET have shown decline in rice yields (Box 2).

Only a single local variety of rice was found at Wandoor: the rest of the farmers use high-yielding hybrids. Karen farmers around Mayabunder in Middle Andamans still use a number of local varieties brought over from Burma several decades ago.

CARI identifies the slow diffusion of HYV and cultivation of existing traditional varieties as major bottlenecks to increased productivity. To date no variety has been released from these islands. If these varieties are based on local cultivars, then these need to be encouraged to enhance crop genetic diversity.

5. 2. 2. Agricultural productivity in the Nicobars

Coconut plantations have dropped in productivity because of aging in the Katchal area. Some recent data collected indicate that the Nicobari methods of cultivating coconut and areca nut may give higher yields than modern methods. Their methods also result in little loss of natural vegetation. There is a sociological problem in increasing productivity, since there appears to be an emotional barrier to replacing trees planted by one's ancestor (Singh, 2000a; b).

5. 2. 3. Loss of biodiversity due to agriculture

The loss in forest area to even 86% of the original will lead to the loss of an estimated 4.5% of species, according to the theory of island biogeography. This was calculated using the value of $Z = 0.3$ (Mac Arthur & Wilson, 1997). Additionally, the use of insecticides will have an impact on insectivorous birds, wetland species and predators.

The fertiliser and pesticide loads in the sea and their biomagnification in marine organisms have never been assessed. It is also extremely likely that the coral reefs are affected. Organic possibilities need to be explored. In the long run, phasing out a number of crops and replacing them with high value agro forestry such as vanilla, cane and bamboo will be required to solve the problem of pesticide use.

5. 2. 4. Wild relatives of cultivated plants

A number of cultivated plants have their wild relatives here. These include vanilla, nutmeg, mango, coconut and mangosteen. These have potential for use in breeding and crop improvement and these are required to be documented and assembled.

5. 2. 5. Biotic constraints on agriculture

With the constant temperature and the high relative humidity throughout the year, coupled with high rainfall, the rapid growth and multiplication of insect pests occurs. Given the year round availability of host plants un-

Table 2. Districtwise livestock and poultry

Category	Livestock Census 1997			Livestock Census 2003		
	Andaman	Nicobar	Total	Andaman	Nicobar	Total
Cattle	52921	7259	60180	54645	8909	63554
Buffalo	14155	49	14204	16144	67	16211
Sheep	-	-	-	10	-	10
Goat	59487	11436	70932	63460	15759	79219
Pig	3258	39578	42836	8517	43684	52201
Dog	25363	4205	29568	34099	8485	42584
Rabbit	92	60	152	704	131	835
Horse/ Donkey	12	3	15	1	-	1
Poultry	739058	61892	800950	843916	86962	930878

Source: Dept. of Animal Husbandry & Veterinary Sciences, 2002.

der these conditions, insects are able to breed continuously often with a complete lack of synchronization of the life cycle. Disease is also a problem here, and causes major crop losses.

Weeds compete very fast with crop plants, and cause significant loss by sharing nutrients and by hosting insect pests. The use of weedicides is not very common and is very often ineffective.

Stray cattle are another problem, and cause enormous damage to field crops and forests. The pasturing of cattle immediately after the rice season is another serious problem for subsequent dry season crops. Rodent damage to field crops is another important factor, with control measures not being practiced by farmers. African snail is a serious constraint for vegetable crops especially during the wet season.

5. 2. 6. Abiotic constraints on agriculture

High salinities, and the high fixation of phosphorus, aluminium and iron toxicities, either individually or in combination, are a regular phenomenon causing low yield. In acute cases lands are abandoned. During the peak dry season water stress coupled with excess heat makes a heavy dent in production particularly in pulse and vegetable crops, as they are cultivated during this season.

5. 2. 7. Ecological constraints on agriculture

About 84% of the total geographical area is under very fragile tropical forest. Any conversion of forestland to agricultural land poses a

threat to the forest ecosystem, which in turn affects the quality of agriculture.

The soils of the islands are very fragile due to their recent origin, and soils in cultivable areas are shallow. Excessive rainfall of high intensity causes topsoil loss each year and proper soil conservation measures are seldom adopted. Water logging due to excess rain-water and flash floods, and the prevalence of acid sulphate soils are serious hurdles in the islands. Aluminium and iron toxicity in low-lying areas and phosphorus deficiency in the virgin hill slopes are serious constraints.

Harvesting and threshing of fruit crops becomes a problem during the rains. During the dry season extensive moisture stress sometimes leads to the complete loss of a crop.

Small irregular plot sizes are the principal constituents of the major land holdings. These are essentially not amenable to mechanical farming. Thus manual farming is the only alternative that makes agriculture a cost intensive avenue in these labour scarce islands.

5. 2. 8. Socio-economic constraints in agriculture

In contrast to the mainland, there are comparatively better job opportunities in the islands. Besides, the people living here have more remunerative and short-term means of income such as fishing and tourism. Thus agricultural activities have become a secondary proposition in many places. Subsidy in the form of seeds, fertilizers, pesticides, and implements impede agricultural development and make people more dependent on the Government.

Table 3. Decline in indigeneous tribal populations.

Name of Tribe	1901	1911	1921	1931	1951	1961	1971	1981	1991	2001
1. Shompen	(348)	(375)	(200)	200	(200)	71	92	223	250	398
2. Onges	(672)	(631)	(321)	(250)	(150)	129	112	97	95	96
3. Great Andamanese	(1882)	(1317)	(786)	(460)	23	19	24	26	45	43
4. Jarawas	NE	NE	(114)	(70)	(50)	(500)	NE	31	(280)	(240)
5. Sentinelese	NE	NE	(117)	(50)	NE	(50)	NE	NE	(100)	(39)
6. Nicobarese	5962	7991	8032	9589	11902	13903	17874	21984	26000	28653
Total	8864	10314	9570	10439	12145	14672	18102	22361	26770	29469

Note: (i) Figures in parenthesis indicate the estimated population. (ii) NE - not enumerated.

Agricultural inputs are insufficient and not available in time because of erratic supply from the mainland, which affects agriculture as a whole. The credit facilities extended by different organizations are not fully utilized by the farming community due to ignorance or due to difficulties in fulfilling official formalities.

5. 2. 9. Future prospects

The major thrust for agriculture development should be on high value products from vanilla, floriculture and orchid cultivation, high value products from coconut and areca nut, and the extraction of oil and oleoresin from cinnamon, clove, pepper, nutmeg and ginger. Modern vegetable cultivation in polyhouses and encouragement for the use of bio-fertilizers should be included in ongoing schemes. Besides multicropping methods should be encouraged.

5. 3. Damage to coral reefs

5. 3. 1. Loss of reef cover

Collection of shells and sea cucumbers for commercial purposes has led to a drastic decline in the occurrence of these two taxa. While they are protected now, the Department of Environment and Forests has not been given the additional resources necessary to enforce the ban on their collection. Assessing reef areas has been identified as a research priority during a seminar on protected areas planning. Degradation has been recorded at a few sites. However, the overall condition of the coral resource in the Andamans is poorly documented; only one detailed study has been conducted, in the vicinity of the MGMNP (Kulkarni, 2000). A recent UNDP/ZSI study has identified newer species of coral in the Andamans taking the recorded coral species number from 197 to 235.

However coral reefs of the islands are under various degrees of threat such as siltation, sand mining, agricultural runoff and damage due to fishing and tourism activities. These are apart from global climatic factors such as sea temperature rise. Remedial measures would have to emphasise the control of further encroach-

ment of forestland and its consequent degradation. This is because sedimentation from the land clearing is one of the main causes of coral mortality (Whitaker, 1994; Kulkarni, 2000; 2001).

Tourists stepping on the corals also cause damage. The reefs around the main tourist sites of Jolly Buoy and Redskin Islands, in the MGMNP, have been degraded due to this reason. Remedial measures would include restricting the numbers of tourists visiting the MGMNP, as well as a proper awareness programme to educate them on how to prevent damage to corals (Kulkarni, 2000; Singh et al, 2002). There is no recent information from the RJMNP; this becomes a priority since a number of dive shops and adventure tour operators have sprung up in the last couple of years.

A tighter control on trawling and net size is also required. The use of TEDS requires urgent study and an implementation process started soon. Annually we lose around 2000-3000 sea turtles (Bhaskar, 1993; Andrews, 2000d; Andrews, et al., 2001). Fishing on or around coral reefs also needs monitoring at the moment to assess its impact. A recent ban on fishing on the six species of shark is going to be extremely difficult to implement without a considerably enhanced protection force with the Forest department and difficulty in identifying shark species from dried fins.

5. 3. 2. Damage due to pollution

Oil spills are rapidly becoming a major concern, especially in the Port Blair region. Ships wash their bilges offshore, and this is damaging coral reefs. Ships also tend to ignore regulations about dumping of sewage at sea. The areas of great concern are Car Nicobar and Wandoor in the MGMNP.

5. 3. 3. Loss of biodiversity due to fishing

In spite of only slightly over 10% of the estimated available catch being harvested, catch of certain species in the coastal areas has been badly depleted. Shellfish in danger of being threatened include *Trochus*, *Turbo*, *Nautilus*, black lip pearl oyster and green mussel. This might be either

a result of the potential harvest being wrongly calculated, or due to bad fisheries practices. However, the sizes of fish caught have declined noticeably, indicating over fishing. The sizes of crabs and lobsters available have also dropped, and the prices of these items are similar to prices on mainland India (lobster is Rs. 350 per kg. at Wandoor, making this important source of protein unavailable to local residents). This is largely due to the export market to Malaysia and Singapore. Crabs are also exported to mainland India for the Malaysia and Singapore markets. These methods have depleted two species of crabs and lobsters all over south East Asia. This requires urgent regulation, mainly closed season during the breeding season and size/weight limits. Overharvesting of crab and shrimp hunting has also taken a severe toll on mangroves in South America and some parts of south Asia, and currently they are into major mangrove restoration efforts. The prices and catch seasons in the Andamans are shown in box No. 3.

It is clear that considerable effort is required to ensure that fisheries are properly managed. Limiting landing sites, preventing fishing in the closed season, and enforcing minimum size rules, mesh sizes are some factors that need enforcing.

Indiscriminate fishing of shark for shark fin may also include certain shark species in the endangered category. Currently tiger and hammerhead sharks have disappeared. The effects on sharks are already noticeable, with the large shark having more or less disappeared, mainly the tiger shark that was once common around the Andaman Islands and has become extremely rare since the late 1980s. The catch effort required to catch sharks is shown in Box No. 4. Other affected items include sea cucumbers and ornamental shells. Several species in the last three taxa have now been placed on Schedule I of the WLP, 1972. The appropriate enforcement measures will need a considerably enhanced manpower to implement.

5. 4. Issues with mangroves

Extraction of mangroves for commercial purposes was stopped in 1989 in the islands and most these areas have regenerated to its origi-

nal form (Andrews, 2000c). However, there are encroachments in mangroves in some of the areas in North, Middle and South Andamans. There is also some degradation due to fuel wood and pole extraction (Sirus, 1999). Recently, there is also a demand to hand over mangrove areas for shrimp farming, a move that will have harmful environmental consequences as it has in South East Asia and South America. There is also a demand for handing over areas for fattening of mud crabs.

5. 5. Issues with coastal ecosystems

The major problem with coastal ecosystems is sand extraction for construction. This has led to loss of marine turtle beaches in ANI and erosion by sea action. In a number of places the sea has destroyed the belts of vegetation bordering it. Manilkara forest has been affected at several sites in North, Middle, South Andaman and Baratang Islands. The regeneration of Manilkara forest has also been badly affected because of the browsing of seedlings by goats, cows and spotted deer. Other problems include litter, garbage, which include plastics, oil and other hazardous waste that get washed ashore. These are locally generated, thrown over by passing ships and a high percentage that come as drift from South East Asia (Andrews & Sankaran, 2002; Dharini et al, 2003). A detailed Integrated Coastal Zone Management Plan for the islands is under preparation by the Anna University, Chennai.

5. 6. Issues with wetlands

Very little is known about the species associated with them, and their unique features other than that reported by Vijayan (1996a), Andrews (2000 b, 2000c; 2000d; 2002) and Andrews & Sankaran (2002). This applies both to forest swamps as well as open swamps. A research effort is required initially to map these areas and do ecological profiles on them. Wetlands are being drained for agriculture and other landfills for development. This is most noticeable around Port Blair, near Sippighat. After 2004 tsunami all this area is under sea water. Pesticide residues are

also likely to have affected wetland fauna in a number of places.

5. 7. 'Island' effects more likely to lead to species extinction

There are 19 endemic bird species found in the islands. Andaman Teal is critically endangered, with major habitat loss having occurred over most of their range, coupled with poaching (Sankaran, 1995, Andrews, 2000b; 2000c; Andrews & Sankaran, 2002). All the others are restricted range species according to the IUCN threat criteria. A detailed status survey of all these, and of other taxa, is required. Filling this knowledge gap will lead to proposals pertaining to regulation of tourism, the regulation of fishing, the declaration of more protected areas and additions to the school syllabus leading to increased awareness.

An analysis of the endemic species shows that there are fewer species in common between the Andamans and the Nicobars than would be expected by chance. This is an indicator that the faunas of the two island groups have evolved separately from each other, and are isolated from each other. This makes research into the fossil record very relevant, as this will help in understanding the processes that have led to the present species distributions on these islands.

Another concept that is relevant here is that of stepping-stones. The distances between protected areas are greater, and emigration of a new species from one protected area to another becomes difficult as more areas are deforested. Having additional protected areas in between the existing ones could mitigate this. With the current rates of degradation that are occurring, it becomes a priority to identify potentially new PAs, taking into account the representation of various slope, relief and soil classes that may affect species compositions.

5. 8. Introduced domestic species: cattle and goats

The livestock in the islands as estimated in the livestock censuses conducted in 1997 and 2003 are shown in Table 2. Between 1980 and

1990 the Department of Animal Husbandry & Veterinary Services (AHVS) imported about 250 cows for the breeding programme. This was stopped in 1990, and artificial insemination is done using frozen semen for upgrading the stock of cattle and buffaloes. 70 Malabari goats were also brought in during this period. There is no stall-feeding done. The problem of free ranging cattle and goats damaging forests has been noted in a number of areas of North Middle, South and Little Andaman Islands, as well as Nancowry and Great Nicobar Islands, including the Jarawa Reserve. Cattle do not normally browse in rainforest / evergreen forests because of the lack of grasses, but do so in open coastal forests. In contrast, goats have been observed at a number of places inside forest areas, especially near villages. While there has been no documented study except on Narcondam Island, observations indicate that damage by goats is occurring. This problem should be tackled right now, while it is still possible to prevent grazing by goats in forested areas.

A list of the introduced domesticated species here follows:

- Cats : Everywhere- feral
- Dogs : Everywhere- feral
- Goats: feral on Narcondam and Barren Islands; domesticated elsewhere.
- Cattle: domesticated and feral, also along the Jarawa Reserve and in Great Nicobar Island.

Problems perceived with poultry and livestock farming that have a relation to biodiversity are: the scarcity of fodder, the scarcity of feed (feed ingredients are imported, from mainland, which becomes a costly affair), and the disease problems resulting from the hot and humid climate,

5. 9. Introduced species in the absence of predators

Three problem species are the chital, barking deer and feral elephant in the Andamans. In the past few years, studies have been carried out on both of these.

Feral elephants are found on Interview Island and on North Andaman Island. About 40

elephants engaged for timber extraction from Interview Island and parts of North Andaman Island by M/s P.C.Ray & Co. engaged by the Administration, were abandoned on Interview Island in 1960s, and these have formed a breeding population. A study in 1993 estimated their population at 70 (Sivaganesan & Kumar, 1995); a survey done in March 2001 estimates their current population at 35 (Ali, 2001). Sivakumar (2003) has also reported problems related to introduced mammals. However, further studies to know the correct population of elephants and their impact on vegetation will be necessary.

Similarly chital initially introduced in the 1930s, for meat and for beautification of the islands, have now spread all over the North, Middle and South Andamans including Baratang and other outlying islands. Hog Deer were also introduced in the North and Middle Andamans, but this species did not survive for long. Barking Deer introduced around 1915, is now common in areas of Middle and Baratang Islands. Saplings of selected species are browsed whose regeneration is affected (Aul, 2002; Ali, 2004). Control mechanisms for chital and barking deer need to be considered as no natural predators are present.

Feral dogs have been reported digging up nests of sea turtles and killing nesting turtles all over the Andaman and Nicobar Islands (Bhaskar, 1979; 1984; 1993; Andrews, 2000; 2001; Andrews et al., 2001). Controlling their population assumes urgency if sea turtle populations are to be protected. Cats are seen to be predators of ground lizards, birds and nesting birds.

Mynahs and palm squirrels have also been introduced into the islands, but their effects on the local fauna and flora have not been studied.

Introduced wild species include:

Chital: Introduced in 1930s; found everywhere in Andamans except Little Andaman, North and South Sentinel Islands.

Hog deer: Introduced in 1905-1930 in North and Middle Andamans; possibly eradicated.

Barking deer: Introduced around 1915; Locally common in Middle, Baratang and South Andaman.

Elephant: Is found on Interview Island and parts of North Andaman.

Common Mynah: Abundant in the Port Blair area and South Andamans, and might be competing with resident hole nesters.

Three striped palm squirrel: Common in areas near Port Blair and spreading towards Wandoor area.

African giant snail is a major pest of vegetable crops all over the Andamans.

House crow is the latest addition which have been recorded from Port Blair during October 2002.

5. 10. Declining tribal populations and loss of indigenous knowledge

There are four groups of indigenous tribes in the Andamans and two in the Nicobars. Their populations are generally showing declining trends except that of the Nicobarcse, who are well assimilated into the mainstream. A comparative table of the populations of various tribes is given in Table 4.

The Great Andamanese are confined to Strait Island. The Onge are under constant disturbance from poachers and settlers in Little Andaman Island. The Sentinelese, still hostile, are undisturbed. However fishermen and lobster divers have been observed very close to coastline and inside bays of this island. This may be keeping the Sentinelese away from foraging in the intertidal reefs during low tide and from fishing out at sea in their dugout canoes (Andrews, per. observ.).

The fourth tribe, the Jarawa, typify the debate ongoing in the islands. They were hostile until five years ago. Recent shedding of hostility has resulted in frequent contacts with settlers and passengers along the Andaman Trunk Road (ATR). The Administration is taking action to reduce the contacts.

One school of thought believes that it is necessary to enable the Jarawa to abandon their forest existence and bring the benefits of "civilisation" to them. Opposed to this is the view that they should be left strictly alone; otherwise they will become extinct. Supporting the latter view are the case histories of

what happened to the Andamanese and the Onge tribes (Portman, 1899).

The Government of India has recently finalised its policy on the Jarawas. The objectives of the policy are (i) to protect the Jarawas from the harmful effects of exposure and contact with the outside world while they are not physically, socially and culturally prepared for such an interface, (ii) to preserve the social organization, mode of subsistence and cultural identity of the Jarawa community, (iii) to provide medical help to the Jarawas to reduce mortality and morbidity in case of their sudden affliction with diseases, which their systems are unaccustomed to, (iv) to conserve the ecology and environment of the Jarawa Reserve Territory and strengthen the support systems in order to enable the Jarawas pursue their traditional modes of subsistence and way of life, and (v) to sensitise the settler communities around the Jarawa habitat and personnel working for the protection and preservation of the Jarawas about the need to preserve this ancient community and to value their unique culture and lifestyle. With the said objectives in view, the Government of India has framed various strategies and guidelines for the protection and welfare of the Jarawas. The strategies include (a) protection of cultural identity by a policy of maximum autonomy to Jarawas with minimum and regulated intervention by the Government, (b) protection of the natural habitat with no exploitation of natural resources within the tribal reserve and a ban on interaction between tourists and the Jarawas, (c) protection of health status by a periodic health surveys and extension of medical assistance in the Jarawa area itself, (d) regulation of traffic on the ATR by limiting it to the essential purposes of public transport, supplies and emergency evacuation of patients with movement only during restricted hours and in convoys, (e) Codification of the Jarawa language, so that the officials of the Administration, who are required to come in contact with the Jarawas, are able to communicate with them and understand their perceptions, reactions and problems, and (f) suitable institutional arrangements for the protection and welfare of all the aboriginal tribes including the Jarawas.

The recent order of the Supreme Court is to close the ATR in the section passing through the Jarawa Tribal Reserve, but the A & N Administration has approached the Court for modification of the Order.

Also at stake here are the largest relatively undisturbed tracts of forests within the islands: the Jarawa Reserve, the Onge Reserve on Little Andaman Islands, and the Great Nicobar Biosphere Reserve, which acts as a home to the majority of the Shompen. Assimilation of the tribes into the mainstream is likely to increase pressure on the lands within the reserve for logging and encroachment, as well as increase in poaching activities.

5. 11. Impact of developmental activities

5. 11. 1. Construction of RCC structures

Developmental activities involving RCC structures require large quantities of sand. This sand is quarried from the beaches. While the Forest department gets royalty on the sand mined, and the sand taken from each area is regulated, this is difficult to enforce in practice. As a result, erosion of beaches has occurred. This has had three major consequences: loss of land and coastal forests, the loss of 21 sea turtle nesting beaches in ANI, and the loss of recreational areas (Andrews, et al., 2001).

In its order, the Supreme Court has ordered that the amount of sand utilised must be reduced to 33% of its current usage within five years. The current system of monitoring needs to be strengthened to enforce this.

5. 11. 2. Developmental activities of Port Management Board

The Port Management Board constructs jetties on remote islands. These jetties very often block the free flow of sand across the beaches. This results in a pile up of sand on one side of the jetty and erosion of sand on the other side. Computer models exist now to predict the erosion that might occur and to design appropriate structures. These are required to be used while designing jetties and deciding on their location.

5. 12. Impact of tourism

Tourism development in the islands in the last decade, has led to the unplanned development of several areas. The numbers of tourists are increasing in spite of the lack of sufficient facilities. This has led to pollution using plastic (controlled only in the MGMNP), camping on sea turtle beaches and preventing their nesting, for example, on Ross and Smith Islands and on Little Andaman Island (Andrews, et al., 2001). Forest fires started by camping tourists have also occurred at Chidiatapu, New Wandoor and on Havelock Islands. Forest fires especially in coastal forests, cultural contamination resulting from exposure to drugs and nudity, and loss to the exchequer due to tourists benefiting from the subsidies on transport, are likely hazards of promoting uncontrolled tourism. Construction of hotels at several locations to accommodate the tourists will result in problems such as garbage removal, effluent release and habitat degradation.

5. 13. Immigration from mainland

The 2001 census reports a population of 3.57 lakhs. Significant increase in the population is due to immigration from the mainland States. The control of immigration becomes one of the top priorities if biodiversity is to be conserved in these islands. The introduction of an island identity card and innerline permit is a first step in this direction, besides elimination of the subsidy on passenger fares for ships.

5. 14. Knowledge of medicinal plants

The ANI is a vast repository of medicinal plants. The islands enjoy a warm humid tropical climate with an annual rainfall of ~3300 mm, which is very congenial for the growth of medicinal plants. The AN DE & F has reported 406 species for the ANI (AN DE & F, 2005). (Dagar & Dagar, 1999). Awasthi (1987) has discussed the use of 35 species by the Nicobarese, 35 by Shompens, 16 by the Great Andamanese and 10 by the Ongc.

Data was gathered by ANET in January 1999 on the plants the Bengali and Chota

Nagpuri settlers used, in the areas around Saddle Peak National Park. It was found that the Chota Nagpuri community has begun using mainly local plants and have developed a rich ethno botanical tradition utilising plants new to them, over the last few decades (Appendix 2). The AN DE & F in collaboration with the National Botanical Research Institute (NBRI), Lucknow has inventoried 406 medicinal plants of the islands (Appendix 15).

5. 15. Impacts of the 2004 earthquake, tectonic plate shifts and the tsunami

The entire reef flats, starting south from north of Constance Bay on the western side of South Andaman, north along Middle and North Andaman Islands, around Landfall island, south around East Island and along the eastern coast of North Andaman to north of Rongat area, are dead and exposed by 0.75- 1 m in height. This is the same for all major out lying islands along these areas, including Little Andaman Island, and is a clear proof of the upheaval of the island's land mass by an average of 1 m (Andrews & Vaughan, 2005).

The mangrove creeks along the same areas have been affected due to the upheaval and high tide waters not reaching into the mangroves, the water level remains 0.75-1 m below the previous level. This caused root shock and drying off the front rows of mangrove trees and shifting of strands into the creeks. These same creeks have been swept of their bottom substratum, leaving sandy bottoms and greatly affecting the fish and other creek fauna.

The mangroves on the eastern side of Middle Andamans, from Rongat Bay, east of Long Island and from north of Baratang Island and in the entire Shoal Bay area remain submerged during high and low tides. This caused drying of mangrove trees and shifting of strands into the creeks. The impacts on mangroves in areas of Rongat Bay, west of Long Island, east Middle Strait Island, Baratang Island, Shoal Bay and around southern South Andaman Island and along west coast to Port Mouat, is a clear indicator of the subsidence of the land mass by 0.75- 1m.

No major impacts were observed along coastal forests in the Andamans, there is scope for quick regeneration in impacted areas on the main and small islands, including Little Andaman Island.

The entire coastal areas and habitats in the Nicobars have been affected due to the subsidence of the islands, destroying and impacting all coastal flora and fauna, including habitats of some mega species. Mangroves, along Nancowrie and Kamorta Islands have been impacted. Two species that has been impacted to a very great extent are *Pandanus nicobarensis* and *Nypa fruticans*. Impacts, to a great extent, on fauna, flora and freshwater sources are on islands like Nancowrie, Kamorta, Trinket and Katchal Islands. Loss of all tracts of *Pandanus* and *Nypa fruticans* in the Nicobars will, to a great extent, affect the dietary habits of some Nicobarese people and all the Shompen people, also due to loss of mangroves and associated food resources (Andrews & Vaughan, 2005; Sankaran, 2005).

The subsidence and upheaval of the islands, and the impact of the tsunami has taken a major toll on marine turtle nesting beaches in the ANI. On Great Nicobar Island domestic animals have become feral, and these include pigs, goats, cattle, dogs, cats and chickens and this is of major ecological significance. The aftermath, ecological changes, impacts to ecosystems, habitats, flora and fauna has been discussed in detail by Andrews & Vaughan (2005), Malik & Murty (2005), Ramachandran et al., (2005), and Sankaran (2005).

6. Identification of relevant ongoing plans and programmes

Each Department was asked for a statement on what ongoing programmes and plans it has relevant to the issues raised above. The following Departments and NGO's have responded.

6. 1. Central government departments

6. 1. 1. ASI

Anthropological Survey of India, Andaman and Nicobar Regional Centre, since its estab-

lishment in 1951, has contributed significantly to the understanding of human society by studying tribal and non tribal populations of these islands. The broad objectives behind these activities remain:

- To take up anthropological studies of scheduled tribes and other communities.
- To reflect in its research programme, the priorities set by the government on conservation of environment, welfare of tribes, women and children and assessment of health and nutritional status
- To take steps to salvage and preserve cultural traits and artefacts faced with the threat of extinction and those, which even, otherwise need to be preserved.
- To study and promote awareness of the rich and composite cultural milieu of Andaman and Nicobar group of islands and its contribution to our cultural heritage.

Specific ongoing studies include one on boat typology and fishing communities. This has attained an in-depth understanding of the traditional culture of several of the tribes found here. It has shed light on the craftsmanship in boat making, methods of propulsion and steering, navigational knowledge and different rituals associated with these.

Another project concentrates on Nicobari crafts and its role in their society. Studies on the growth and development of children, and in the urban anthropology of Port Blair and Rangat, are also being carried out.

Of special relevance to our understanding of tribal groups is a study on how tribal communities traditionally use and manage their environment and natural resources, and this is focussed on the Onge and Nicobari communities. Of special relevance to the NBSAP is a study of the contacts and conflicts with Jarawa tribes.

6. 1. 2. BSI

The BSI has been operational in the Andamans since 1972. Its major concerns are the

- Survey and exploration of the plant wealth of ANI

- Compilation of the flora of these islands;
- Conservation and utilisation of the plant wealth here; and
- Studies on the mangroves of these islands.

Minor areas of research include the identification of plant specimens and taxonomic studies, ethno-botanical studies on the tribes, environmental impact assessments (EIA) and ex-situ conservation of rare and endangered plants in the experimental garden-cum-arboretum.

The BSI herbarium contains over 21,000 specimens belonging to over 2000 species. The museum has 400 exhibits including timber yielding plants and other botanically important specimens. The library has 3730 books, and subscribes to 20 foreign and 36 Indian Journals.

A Botanical Garden was established in 1977 on 30 ha. of forestland near Dhanikhari 16 km away from Port Blair. The main objectives of this Botanical Garden are:

- Comparative study of herbarium specimens with plants occurring in nature.
- Introduction of economically important plants from the islands as well as from the mainland.
- Introduction of Ethno-Medicinal plants which are used by different tribes of these Islands, so that they can be propagated and useful compounds can be evaluated.
- Introduction of plants that are found in ANI and South East Asia, but not in mainland.
- Introduction and propagation of Wild germplasm.

An orchidarium and fern house are part of this botanical garden, together with bamboos, canes, gymnosperms, wild gingers, medicinal plants, wild edible fruit trees and sources of green manure.

Another botanical garden has been opened at Kalpong in collaboration with the National Hydroelectric Power Corporation. This botanical garden has different sections such as Medicinal Plant Plot (Dhanvantri Udhyan), Pomological Plant Plot, Palm Plot, Cane Plot,

Endemic Plant Plot, Orchid House, Ornamental Garden, Nursery, Green House and Arboretum. About 64 plant species of high medicinal potential were introduced in Dhanvantri Udhyan. Likewise, about 23 species of wild edible fruit trees, 19 species of ornamental plants and nine species of palm varieties were introduced in the Pomological Plot, Ornamental Plant Plot and Palm Plot respectively. The Endemic Plant Plot houses about nine species of endemic, rare & endangered plants that were collected from the wild. The conservatory has good collections of orchids where 70 accessions of live orchids are conserved and propagated including several endemic and exotic species. BSI here has described 60 new species and three new genera; over 310 scientific papers have been published. Vol. II and III of the Flora of the Andaman and Nicobar Islands are under preparation. The Flora of Great Nicobar has been published.

Besides this, wild relatives of nutmeg and betel palm have been explored. BSI was involved with the EIA of the Kalpong project, and is helping various groups in identification of plant species for their commercial exploitation. However, emphasis is being laid on the mangrove zonation of these islands.

6. 1. 3. CARI

Central Agricultural Research Institute (CARI) is entrusted with the onerous task of catering to the needs of these islands' ecosystem by forging a research base to enhance crop, livestock and aquatic productivity through the judicious use of the rich and diversified though fragile natural resource base of these islands.

The Institute has defined role to address the issue of ushering sustainable agricultural development in the island ecosystem. Preserving the biological resources found here is of paramount importance. Hence collection, mapping and conservation of agro and animal genetic resources have assumed considerable importance. CARI is in a unique position to assume this responsibility.

There is a need for appropriate technology here. It is in this context that CARI can play

a pivotal role in carrying out research and development activities so that technologies may be generated that suit island condition or technologies developed in mainland India can be suitably modified, according to island conditions.

CARI conducts research on various aspects of agricultural activity in the islands, including testing of new cultivars and experimentation with new breeds of domesticated livestock.

6. 1. 4. CDRI

The Central Drug Research Institute identifies plants that have medicinal value and carries out tests on their efficacy. They have conducted studies here as well, and a greatly enhanced role for them is required.

6. 1. 5. Department of Space

Many organizations of the Department of Space, viz., Indian Institute of Remote Sensing (IIRS), Dehra Dun, Indian Space Research Organization (ISRO), Bangalore, National Remote Sensing Agency (NRSA) and Vikram Sarabhai Space Applications Centre (VS-SAC), Ahmedabad have been involved with aspects of mapping and remote sensing of natural resources in the Andamans. A project on Biodiversity characterization at landscape level has been conducted by the Department of Space in collaboration with the Department of Environment and Forests. It has also prepared the National (Natural) Resource Information System (NRIS). VSSAC has prepared a Coral Reef Atlas of India, including the areas of these islands.

6. 1. 6. ICFRE

This is the apex body in the country constituted for the purpose of forestry research and education. It carries out research of national importance as well as regional importance through its research institutes spread throughout the country. The research needs of the ANI are attended to by the Institute of Forest Genetics and Tree Breeding, Coim-

bator. Recently the Institute had funded a Planting Stock Improvement Programme for establishment of Seed Production Areas of *Pterocarpus dalbergioides*, *Casuarina equisetifolia* and *Paraserianthes falcataria* in these islands. The National Forestry Research Plan has identified areas of research, which are required to be carried out by the research wing of AN DE & F Islands in collaboration with the Institute of Forest Genetics and Tree Breeding (IFGTB). The important areas of collaborative research are:

- Biodiversity conservation and utilization
- Biodiversity assessment and monitoring
- Natural regeneration of important tree species
- Soil and water conservation
- Studies of mangrove forests, eco-tourism, wildlife protection, the environmental impact assessment, and nursery techniques of important trees species
- Studies on growth and yield of important tree species
- Human resource management problems
- Protection of endangered species
- Development of marine eco-system
- Planting stock improvement of important species
- Management of wetland and
- Farm forestry package for rural areas

The IFGTB has now proposed the following collaborative projects with the AN DE & F, but the work is yet to start:

1. Regeneration ecology of economically important tree species of ANI.
2. Genetic variability and selection in natural population of *Artocarpus* species.

Besides, IFGTB, Coimbatore, the Forest Research Institute, Dehra Dun is also carrying out certain projects in these islands. It is now in the process of revising the 'Forest flora of Andamans' by Parkinson.

6. 1. 7. ZSI

ZSI has been conducting surveys of the various faunal groups in the islands. It has just completed a survey of the coral reefs in the islands, in March and April 2001.

6. 1. 8. ANIFPDC

The ANIFPDC has been involved in the management of leased forest areas of Little Andaman and North Andaman. It also carried out plantation activity and natural regeneration of tropical forest. It maintains rubber & red oil palm plantations. It is now becoming involved with ecotourism.

6. 2. Union Territory Administration's Departments

6. 2. 1. AH & VS

The AH & VS has imported quality animals in the past for upgrading the stock found locally. It is involved in establishing goat farms. While import of cattle has been stopped, artificial insemination using frozen semen is now used to upgrade stock. It is estimated that the number of cattle on the islands will decrease because of both the introduction of superior stock as well as the reduction of scrub animals.

6. 2. 2. ANDE & F

The Department of Environment and Forests is the largest manager of land and biological resources in the islands. 7171 km² out of the total area of 8549 km² area of the islands (86%) is Protected Forest, Reserve Forest or Protected Area, and comes under the management of this department. Protection of forests remains the primary charge of the department. 70% of the forest area is totally protected and therefore the department has to engage a large force to protect the area from all kinds of interference. It implements and enforces a large number of legislations for this purpose. It had set aside 30% of the forest area for production forestry and had operated 15% of the forest area under the Andaman Canopy Lifting System from 1952 to 2002. This 15% area is now required to be managed for meeting the local needs of timber and NTFP. Though the Department had formulated a State Forestry Action Programme (SFAP) for the period from 1997 to 2017, as a part of the National Forestry Action Programme (NFAP), this would require a

drastic change in view of the recent orders of the Supreme Court accepting the recommendations of Shekhar Singh who was appointed as Commissioner to report on the State of forests and other allied matters. The department also undertakes research in various fields of forestry and wildlife either alone or in collaboration with other reputed organizations, generally following the guidelines formulated in priority areas identified in the National Forestry Research Plan (NFRP), prepared by the Indian Council of Forestry Research and Education. The state level research priorities identified in the National Forestry Research Plan and the prioritized research problems for Andaman & Nicobar Islands are the following:

- Biodiversity conservation and utilization
- Biodiversity assessment and monitoring
- Natural regeneration of important species
- Wood preservation techniques
- Soil & water conservation including integrated watershed management
- Studies on mangrove forests
- Protection of wildlife
- Environmental impact assessment of eco-tourism
- Nursery techniques
- Studies on growth and yield of important species
- Human resource management of forest department.

The management of the wildlife and protected areas is carried out as per the National Wildlife Action Plan (2002-2015). Keeping in view the recent trends in forest and ecosystem management, the department has proposed new schemes for ecotourism, mangrove area management and forest protection in the 5-year Plan (2002-2007). Continuing schemes include: strengthening of the forest administration, training, research, survey and demarcation, natural regeneration, NTFP development, forest extension, resource survey, saw milling and wildlife & biodiversity conservation. In implementation of these programmes and schemes, the department takes into consideration the various recommendations of the committees, commissions, workshops, seminars and research organizations which have been accepted by the Govern-

ment. These include: the Coimbatore Charter on Environment and Forests, Report of the Committee on Prevention of illegal trade in wildlife and its products (Subramaniam Committee), Committee on Improvement in the service conditions of Range Forest Officers (Pande Committee), Committee on Human Resource Development (Tiwari Committee). The department also takes care of all the subjects addressed under the various U. N. Conventions and agreements, including climate change, biodiversity, ozone protection, desertification, wetlands, forestry and hazardous substances. The department is the enforcing agency of various Central legislations like the Indian Forest Act, 1927, Wildlife (Protection) Act, 1972, Forest (Conservation) Act, 1980, Environment (Protection) Act, 1986, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, 1976 and all the rules framed under the above Acts, which have a direct bearing on the conservation of biodiversity. The department in collaboration with the Directorate of Education and the C.P.R. Environmental Education Centre is implementing the programme of National Green Corps, for the purpose of creating environmental awareness among the school children, besides organizing various programmes independently on the occasion of World Forestry Day, World Environment Day, Van Mahotsava and the Wildlife Week.

6. 2. 3. DRDA

This Department implements development schemes in the rural areas. Many of these, such as check dams and rural water supply, are dependent on the healthy state of the watersheds.

6. 2. 4. Directorate of Fisheries

This department licences fishing boats and fishing/shell fishing in earmarked areas, maintains fisheries statistics and enforces regulations laid down by the Fisheries Regulation and shell fishing Regulation. The current ban on sharks, sea cucumber and shells will mean that the licenses it provides will have to be drastically curtailed. Enforcement of the

WLPA (1972) provisions will be in the hands of the Forest Dept.

6. 2. 5. DIP & T

The Information, Publicity and Tourism (IP & T) Dept. sets tourism policy for the islands. It has built and maintains a number of tourist guesthouses, most notably in Port Blair, and at Cuthbert Bay and Kalipur. It has identified several areas in which tourism is to be expanded. Environmental concerns have to be in the forefront in choosing sites for tourism. As per the recommendations of Shekhar Singh Commission accepted by the Supreme Court, tourism in all forest areas has to be controlled and regulated by the Forest Department and no permanent/ concrete infrastructure is to be created in forest areas for tourism.

Of special note here is the Master plan for Tourism prepared by the World Tourism Organisation. This makes calculations of tourist carrying capacity based on water availability and the capability to treat sewage. The carrying capacity projected appears to be high and caution needs to be exercised before implementing any of this. Further studies are required and these are addressed later in this document.

6. 2. 6. Revenue Department

This Department controls most of the non-forest land in the islands. These include the agricultural lands around the settlements. It also controls access to the Nicobar Islands, by means of administering a tribal areas permit system, as well as to all the tribal reserves

6. 2. 7. JNRM

The Jawaharlal Nehru Rajkeeya Mahavidyalaya (JNRM) is the only degree college in the islands, and is affiliated to Pondicherry University. Faculty members have carried out research on butterflies and mangroves.

6. 2. 8. Directorate of Tribal Welfare

The Tribal Welfare Dept. oversees all aspects of the welfare of the different tribal

groups of the ANI and has produced a master plan, which requires review and modifications. The Tribal Reserves of Andamans are legally Reserved Forests and come under the control of the Dept. of Environment and Forests as well as the Deputy Commissioner, who implements the Andaman and Nicobar Islands (Protection of Aboriginal Tribes) Regulation.

6. 3. Research institutes

6. 3. 1. KFRI

KFRI has done research on rattans of the islands (Renuka, 1995).

6. 3. 2. Pondicherry University

The Ecology Dept. of Pondicherry University has sent a number of researchers usually working towards their master's thesis, supported by ANET. Research done has been on epiphytes, forest regeneration, bird and butterfly distributions, and on little known species such as the Andaman day gecko, marine turtles and the yellow-lipped sea krait. The Tourism Administration Dept. has also done some work on aspects of tourism here. The University has established a Centre for Ocean and Island Studies, which has a marine biology department, offering a M. Sc. degree in marine biology since 2000, and this will meet the need for marine biologists for these islands.

6. 3. 3. SACON

The Salim Ali Centre for Ornithology and Natural History has conducted research on a number of important bird species that are endemic to these islands. These include the Nicobar megapode, the Narcondam hornbill, and the Andaman teal. Currently there is an important project going on ex-situ conservation of edible nest swiftlets. SACON has also carried out a study of feral elephants on Interview Island in 1993.

6. 3. 4. WII

WII has been involved in a study of the coral reefs of the MGMNP. This includes 30 new records for the islands, and was published in September 2000.

6. 4. Non-governmental organisations

6. 4. 1. ANET

This is a division of the Madras Crocodile Bank Trust and maintains a research station at North Wandoor, South Andaman. It is involved in research covering a number of taxa and education programmes covering several schools. It has advised the Department of Environment and Forests on a number of wildlife and conservation related issues. It has experienced researchers and is positioned to initiate any ecological study rapidly.

ANET conducts a variety of biological research programmes, including biogeography and ecological studies and survey of herpetofauna, sea turtles and crocodiles since 1977. Another research priority of the Team is to understand the requirements and feelings of the islanders to help develop practical and culturally acceptable means of utilising the islands' natural resources in a sustainable fashion.

ANET aims to teach local people of the "workings" of the fragile island ecology and help them understand the dangers of putting too much pressure on its resources. The Team also endeavours to instill a greater level of environmental awareness; that is, stakeholders are encouraged to appreciate nature and take an active interest in conserving the islands wildlife and habitats. Further to this, ANET supports and trains local teachers, school children, settlers, people from the armed forces and naturalists so that they can build upon its conservation efforts. It has also helped produce an environmental education book, "Treasured Islands" for teaching school children, in two languages.

6. 4. 2. AAJVS

This agency is responsible for implementing welfare programmes for the tribal groups in the islands.

6. 4. 3. BNHS

BNHS has conducted several bird surveys in the islands.

6. 4. 4. SANE

SANE has been at the forefront of environmental activism in the islands. It was responsible for the PIL that led to the recent judgement of the Supreme Court.

6. 4. 5. WWF

WWF has funded conservation volunteers here who have worked in the field of watershed management.

7. Identification of stakeholders

The Government Departments, Research Institutions and the NGO listed above, who are the major stakeholders, were asked to define their stake in biodiversity issues. The following issues relevant to the stakeholders have been identified:

7. 1. Central Government departments

7. 1. 1. BSI

The Botanical Survey of India has major research programs, detailed earlier.

7. 1. 2. CARI

CARI does research on various aspects of agricultural productivity, including crop trials and problems caused by insect pests.

7. 1. 3. CDRI

CDRI is conducting studies on medicinal plants and on malaria control.

7. 1. 4. Dept. of Space

The Department of Space has collaborated with the Department of Environment and Forests in the project on Biodiversity Characterization at Landscape Level, and has provided management inputs in identifying the areas that are biologically rich and areas that are vulnerable and which need increased protection. It has helped in use of Geographical Information Systems (GIS) in forest administration, planning and resource management by establishing the National (Natural) Resource Information System.

7. 1. 5. ICFRE

ICFRE is carrying out collaborative projects with the Department of Environment and Forests, through its institutes, especially, Forest Research Institute, Dehra Dun and the Institute of Forest Genetics and Tree Breeding, Coimbatore.

7. 1. 6. NBRI

NBRI has carried out a project on medicinal plants and their use by various communities. The ongoing project on bio prospecting of medicinal plants would continue.

7. 1. 7. ZSI

The Zoological Survey of India has recently implemented a major project funded by UNDP where intensive work was done on the taxonomy and classification of marine organisms.

7. 1. 8. ANIFPDC

ANIFPDC was involved in logging and plantation operations, especially on Little Andaman Island. It is now getting increasingly involved

in promoting eco-development/ ecotourism activities.

7. 2. Union Territory Administration's Departments.

7. 2. 1. DE & F

This is the largest land manager in the Andamans. 7171 km² out of the total area of 8549 km² area of the islands (83%) is either Protected Forest, Reserve Forest or Protected Area, and comes under the management of the Department of Environment and Forests

Timber operations will be carried out to meet the local needs. Encroachment in forest areas is a major problem, and effective steps are being taken to evict the encroachers and to prevent further encroachments. The additions to the schedules under the Wildlife (Protection) Act, 1972 made in 2002, which protect sharks, shells, and sea cucumbers, will be enforced by the Forest Dept. Additional investments in training and new staff will be required if it is to fulfill its role

The increasing importance of wildlife and biodiversity conservation would require strengthening of the wildlife wing, with additional manpower, mobility, research capability and setting up of a Wildlife Crime Records Bureau and Wildlife Forensic Science Lab. The increasing concerns of the environmental protection would require strengthening of the environment wing also with capacity building to detect and abate environmental pollution and also for prosecution of polluters.

7. 2. 2. Fisheries

The increased emphasis on promotion of fisheries would require the department to play a greater role both as a facilitator and a regulator. Future potential lies in deep-sea fishing, brackish water aquaculture, mariculture, mud crab fattening, pearl culture and tiger prawn production.

7. 2. 3. IP & T

The Information, Publicity and Tourism (IP &T) Dept. sets tourism policy for the islands. Tourism is yet another priority sector identified for the economic development of the islands. Tourism will have effect on the utilization of the resources available in these islands and the accompanying pollution. Tourism in coastal and forest areas will have impact on the marine and forest ecosystems. Controlled development of tourism with no or low impact on the environment is called for.

7. 2. 4. Tribal Welfare

This Dept. is to ensure the welfare of the tribes. It sets the policies for tribal welfare, and the implementation is done by the AAJVS, nominally an NGO but whose executives are civil servants. This has to work hand in hand with the Anthropological Survey of India.

7. 3. Research institutes

7. 3. 1. CAS in Marine Biology (Annamalai University)

This is carrying out research on the marine flora and fauna of the Great Nicobar Biosphere Reserve.

7. 3. 2. SACON

SACON has conducted surveys on a number of threatened bird species in the islands, namely, Nicobar Megapodes, Narcondam Hornbills, Andaman Teal and Edible-nest Swiftlets. It is currently implementing a programme for in-situ and ex-situ conservation of the swiftlets.

7. 3. 3. WII

WII has conducted a survey of coral reefs in the MGMNP. At present, it is engaged in a study on consolidation of protected area network and elimination of exotics from these islands.

7. 4. NGOs

7. 4. 1. ANET

ANET is the oldest environmental NGO in the islands.

7. 4. 2. AAJVS

This organization implements the tribal policy of the A & N Administration.

7. 4. 3. Andaman Science Association

The Andaman Science Association publishes a journal where scientists from different disciplines contribute articles relating to these islands. These form a very important reference material.

7. 4. 4. SANE

An environment activist group that has been in the forefront in several issues. It has been active in espousing tribal causes, and has Public Interest Litigation ongoing to prevent encroachment in the Onge Reserve as well as to reduce contact with Jarawas.

7. 4. 5. WWF

WWF has a conservation volunteer in the islands at the moment. It has implemented a village pond in Wandoor village for the supply of water during the dry season.

7. 4. 6. Kalpavriksh

Kalpavriksh has been involved with ANET in the islands for several years. It has brought out a teachers manual with ANET that has generated a great deal of interest in the environment of the Andaman and Nicobar Islands. Recently they are involved in litigation regarding logging and tribal affairs.

7. 4. 7. CPREEC, Chennai

This is the Resource Agency for the implementation of the National Green Corps in these is-

lands in collaboration with the Department of Environment and Forests and the Directorate of Education.

7. 5. Settlers

The different settler groups that have been identified are:

7. 5. 1. Bengali

Bengalis were brought in as settlers in the 1952-3, with Middle Andamans being used for settlement in the early 1950's and North Andaman around 1957-1959. After this, there has been a continuing influx especially over the last decade. These appear to be predominantly refugees from Bangladesh, and they have become rural farmers. Some of them have converted to fishing. Medicinal plants used are mainly ones brought by them from Bengal. Bengali settlements in Little Andaman happened between 1969-1974, and part of the Onge Reserve was denotified as a result of this.

7. 5. 2. Chota Nagpuri

This community has several components, mainly tribes from the Jharkhand and Chattisgarh regions. They were brought here before independence as forest labour. More arrived after 1948 to clear land for the new wave of settlers. They occupy mainly Government jobs. In rural areas they are concentrated around Baratang Island. They have developed rich ethno botany from the local plants.

7. 5. 3. Tamil

These are mainly recent immigrants, and tend to come from the Ramnad area of Tamil Nadu. A number also moved here from Burma, where they had previously been settled. They are mainly urban dwellers, and form a significant part of the fishing community. They are also involved with business, transport, trading, contractors, construction labour, sand mining and road work.

7. 5. 4. Telugu

An estimated 75% of the fishermen here belong to this community, and are from Nellore, Srikakulam and Vishakapatnam.

7. 5. 5. Sri Lankan Tamil

Refugees from Sri Lanka were settled here in the 1960's. There is a settlement growing rubber on Katchal Island in the Nicobars.

7. 5. 6. Karen

Karens were brought to the Andamans from Burma as forest labour in 1925. The community numbers 3000 totally, of which 600 live near Mayabunder. They are agriculturalists, fishermen, and work in Govt. Departments. Other communities have adopted their dug out canoes for fishing and transporting.

7. 5. 7. Malayali

The Moplah community was brought here as convicts in the 1920's. Recently there has been an influx from other parts of Kerala. They are rice cultivators in North Andaman (Keralapuram) and in Middle Andaman (Betapur). A substantial number hold government jobs or are shopkeepers.

7. 6. Hoteliers

A large number of hotels have sprung up, especially in the last decade, to cater to the increased inflow of tourists. These range from small lodges to large resorts, ranging in quality up to 3-star status.

In urban areas, most of the smaller hotels are badly located and built, and lead to both congestion and the production of untreated effluents. In coastal areas there is pressure from business interests to relax the CRZ regulations to allow new complexes near the beaches. These are likely to lead to major environmental degradation if approved.

7. 7. Tour operators

A lot of new businesses have come up in the islands over the last decade. A substantial number cater to the needs of tourists. These include travel agents, boat operators, tour guides, taxis, van and bus operators. They also include transport vehicle operators who depend substantially on tourism.

7. 8. Indigenous people

The different tribal groups are heavily dependent on natural resource use. The Nicobaris are dependent on fishing; the Andamanese, Jarawa, Ongc, Sentinelese and Shompen are hunter-gatherers. The resource use patterns of the different tribal groups are not understood and these need to be studied as a first step in any programme oriented towards their welfare.

7. 9. Fishermen

These include domestic fishermen and foreign poachers. Information - both primary data as well as from other sources- is being gathered on type of catch, fishing areas, and quantities taken. A preliminary analysis shows that 10 shark fishermen account for over 240 tonnes of shark catch per year.

From the fishery point of view the indigenous populations of ANI do not have a fishing community as such though they are known to catch fish for their own consumption. Fishing as a commercial activity is of a relatively recent origin. Fishermen from Andhra Pradesh, Kerala, Tamil Nadu and West Bengal have come to the islands through the settlement scheme of the Government or voluntarily. There are about 2256 fishermen families with a population of approximately over 11500. The population of active fishermen are around 2150.

Traditional craft, dinghies, and motorized and small-mechanized boats mainly carry out fishing. The fishing fleet of the Islands comprises of 1262 country crafts, 247 motorised and seven mechanical boats.

7. 10. Defence

The Navy and Coast Guard play a major protective role in guarding against poaching by foreign vessels. In 2001, the Andaman and Nicobar Command was established and is a joint command for the defence services. This will lead to the induction of many more personnel into the islands and an increased infrastructure. Proper environmental planning has to be integrated into the expansion of this Command to avoid degradation.

8. Cross-cutting themes

8. 1. Gender

No special issues pertaining to gender issues have been identified in the course of preparing this document, except for the fact that women do not fish; in some communities they are involved in marketing and trade. Several work in Govt. departments, schools and the college.

8. 2. Equity

Money lending is extremely prevalent in rural areas, especially among the Bengali and Tamil community. Interest rates are usurious, and this leads to a greater use of natural resources than necessary.

8. 3. People's Empowerment

The decisions as to where and how Government funds should be spent are taken in Port Blair, itself in most of the cases. The process of consultation with the public representatives is through the District Planning Committee, which approves the various proposals put forward by the Government Departments.

9. Actions needed to plug gaps and strengthen ongoing programmes

The ANI are one of the ecologically most sensitive bio geographic zones of the country. It has been demonstrated that small actions here

have major impact, impacts that would not be felt elsewhere. It has to also be noted that 19% of the fauna here is endemic, so loss of area leading to extinction have more serious consequences here than elsewhere.

The NBSAP paradigm here must be to protect as much of this area as possible. Revenue would be earned from tourism and sea-based activities after a careful study. Agricultural activity is deleterious and must be phased out. Immigration and encroachment are the top priority for enforcement agencies.

Site-specific threats have been dealt with in Appendix 3. The more general ones are given below.

9. 1. Impact assessment of tourism on biodiversity

What is known?

Existing tourist spots are getting increasingly polluted, with noise and plastic. Increased encroachment for constructing shops and lodges has occurred. Corals have been damaged, occurrences of beach forest fire and compacting of turtle nesting beaches.

The existing infrastructure is inadequate to support increased tourism. There is scope for low volume, high value tourism, preferably eco-tourism on limited circuits without creation of any permanent structure in the forest areas.

Summary of actions to be taken:

- EIAs to be done before opening up new areas for tourism (see under 'Multi-sectored' action plans).
- Involvement of local residents in development activities, and ensuring that benefits from any development go to them.
- Establishment of the appropriate protection and monitoring mechanism to control tourism.
- Prevention of environmental degradation to corals and other natural resources through an awareness generation programme.
- Elimination of subsidies for tourists.
- Elimination of tribal tourism for VIPs and restricting the same touted by travel agencies and tour operators and hotels.

Summary of research priorities:

- Impact assessment of existing tourist sites, the benefits it has brought in terms of development to the area, and the additional income to the residents.
- Determining whether carrying capacity is relevant to the context of the islands and determining limiting factors due to infrastructure, transport and food availability.

9. 2. Impact assessment of forestry operations on biodiversity

What is known?

Preliminary studies have shown that the forest structure and composition have changed because of logging. Changes were noted in most areas out of the 15% forest area taken up for operation under the Andaman Canopy Lifting System, as per the objective of management to increase the commercial value of the forest. Timber and MFP are important items for local use. Forest protection is the primary charge of the AN DE & F, but its infrastructure for the purpose of mobility and communication as well as manpower is inadequate to perform this function effectively. Boundary disputes exist between the forest and the revenue areas, which need settlement quickly for effective protection. The subordinate forest staff need training in enforcement of various legislation and also in recent trends in forestry and forest management. The residential buildings available with the department are inadequate for the manpower required, especially in the remote and difficult areas, and this acts as a disincentive for serving in remote areas. There are a large number of protected areas, but many do not have management plans. Timber utilization needs improvement and facilities for timber treatment need augmentation. The coastal ecosystems are threatened by sand collection and need effective protection. The mangroves are rich and need protection. Low volume, high value eco-tourism needs to be promoted in forest areas for the purpose of education.

Actions to be taken:

- Information on various aspects of the functioning of the department needs to be collected, analyzed and disseminated for efficiency and for transparent and responsive administration. This should be done through application of Management Information System (MIS) and Geographic Information System (GIS) and establishment of Local Area Network (LAN) connecting all the offices. Effective communication network should be established through VHF and HF wireless communication.
- Since logging is being restricted to meeting only local needs, the introduction of Reduced Impact Logging is possible. Reduced Impact Logging using only elephants is more favourable to the mechanical logging using tractors and bulldozers.
- Large-scale cultivation of cane and bamboo on all degraded land has to be taken up as a high priority long-term activity. The research leading to this has to begin immediately. Introduction of solid/thick walled bamboos not found in these islands would help in meeting the constructional needs in the rural areas and reduce the pressure on forests for ballies and posts, which is currently reducing the regeneration of forests. This should be done after proper trials.
- Removal of trees from private hilly lands should be done by the AN DE & F, and not by contractors. Suitable legislation has to be enacted to regulate felling in non-forest areas.
- The forestry training needs to be strengthened with in-service training, promotion-linked training, etc., especially in implementation of the various legislation and latest forestry practices.
- The Forest Settlement process needs to be expedited, and forest land records should be created after settling all boundary disputes between forest and revenue areas, for effective protection as well as forest management. Modern technology, such as GIS, should be employed.

- In view of the recent orders of the Supreme Court, all Working Plans are being revised.
- The National Green Corps established in 100 schools should address various subjects such as solid waste management, pollution control, afforestation, maintenance of parks and open spaces, dissemination of information and creation of awareness. The extension activity shall be expanded with the involvement of the Panchayati Raj Institutions.
- The staff posted in difficult and far-flung remote areas shall be provided with proper accommodation, so that they can effectively attend to forest protection and afforestation.
- The Protected Areas shall be covered by Management Plans and the Wildlife wing shall be strengthened to cope with the increasing pressure, due to extension of the area to be protected to marine ecosystem also. Capacity building in habitat management and monitoring should be the priority. Ex-situ conservation when required can be carried out in the Biological Park under construction.
- Poaching and illegal trade in wildlife can be controlled by increasing the mobility and communication facilities of staff, organizing intelligence gathering and crime prevention, better coordination with other law-enforcement agencies and extra vigilance at exit points of this territory.
- The saw milling should be made more efficient by modernization and timber treatment facilities should be augmented to increase the life of timber and thus reduce its use.
- The protection along the coastline must be strengthened through increased mobility and communication network.
- The mangrove areas should be surveyed and mapped; the biodiversity in this ecosystem must be assessed and documented. The mangrove areas degraded by excessive exploitation should be reforested.
- Bee keeping and vanilla cultivation needs to be encouraged as an income activity especially in areas where pesticides are not used.
- Cane processing units should be recognised as industries, to supply furniture, etc. for local consumption only. The cultivation of canes and bamboos on private and revenue lands has to be encouraged.
- The A&N Administration must pass a set of rules to complement the Indian Forest Act, to strengthen its provisions to meet the requirements of these islands, as the current laws have a lot of loopholes.
- Only ecotourism, and no other, should be promoted on limited circuits mainly with a view to facilitate education and appreciation of nature. Except for some heritage tourism around Port Blair.

Research priorities:

Biodiversity assessments and conservation: The extent of biodiversity at landscape level, species level and genetic level needs to be assessed and monitored continuously for the purpose of conservation and utilization. Various research organizations such as Dept. of Space, BSI, ZSI and Institute of Forest Genetics and Tree Breeding have to be involved in the process.

- *Mapping of forest areas:* A comprehensive exercise to map all existing forest areas, forest types and other land uses, using a combination of satellite imagery and ground truthing is an urgent priority. This will enable identification of priority areas for conservation and help in taking management decisions related to the number of personnel and resources to be deployed in an area. This will also enable the identification of fresh encroachments. This needs to be done within the next three years.
- *Changes in forest structure due to logging:* Enumerations need to be carried out at sites all over the islands to compare the composition of logged sites of various ages with adjacent unlogged ones to establish the extent of the change. A detailed evaluation of Natural Regen-

eration Areas is also necessary. This will enable areas to be identified for future logging operations that may be necessary to supply local needs.

- *Permanent study plots:* These include sample plots, preservation plots, tree increment plots, canopy manipulation plots, introduction trial plots, seed production areas, seed orchards, and mangrove plots. This network needs strengthening and expansion.
- *Browsing by introduced herbivores:* The presence of herbivores has affected forest regeneration on logged sites because some species are selectively browsed. Enclosure experiments to exclude herbivores in both unlogged forest and natural regeneration areas are required to assess accurately the damage caused by these herbivores and the control measures to be taken.
- *Genetic improvement of plants:* In the area identified for timber extraction to meet the local needs, the tree crop needs to be improved by enrichment plantation using genetically improved planting material. This requires carrying out genetic improvement of the species for getting quality planting stock. Study is required on the seed biology, phenology, nursery techniques and macro propagation methods of a large number of species.
- *Pilot experiments for afforestation:* Areas of degraded land are to be found at numerous places. Also, agricultural production in certain areas is already so low as to make farming non-remunerative. These areas need to be brought under tree cover and to avoid any adverse ecological impacts only local species should be used. The silviculture of many species, especially bamboo and cane, is not known, and research is required. Demonstration plots need to be set up where local residents can see the benefits of planting various species.
- *Alternative livelihoods:* Information on income generation through fisheries, tourism, forest products and other alternatives to wood based industries is ur-

gently required to make informed decisions on redeployment of staff currently involved with timber extraction.

- *Rare and endangered plants:* Systematic studies need to be conducted on the geographical distribution, habitat, and propagation of rare and endangered species of plants that have already been identified.
- *Forest ecology:* Studies on various aspects of the ecology of the different types of forests in the islands need to be taken up. These include studies on nutrient cycling and hydrology. Soil and water conservation techniques also are important in this high rainfall area.
- *Socio-economics:* Detailed studies of the socio-economic aspects of the use of the different forest products will enable the identification of critical stakeholder groups who can be targeted for development activities.
- *Wood preservation techniques:* Further research to conserve timber resources, of which about 20,000 m³ will continue to be used annually, is required. While considerable progress has already been made, timber preservation techniques appropriate to the local species need to be developed and promoted even further.

9.3. Impact of sand mining on biodiversity

What is known?

Sand mining leads to the loss of beaches, loss of coastal forest and reduction of sea turtle nesting habitats. It also reduces the value of the beaches for tourism. Jetty construction leads to the build up of sand on one side of the jetty, and erosion on the other.

Currently, after the 2004 tsunami, most beaches have been swept away and any removal will only lead to further inland destruction. The beaches will form again, but may take 3 to 6 years.

Actions to be taken:

- Licenses to be given for production of pulverised granite, which is used as a substitute for sand on other oceanic islands. Granite quarrying sites to be se-

lected after proper impact assessment, to prevent the recurrence of ugly landscapes. Stricter monitoring of illegal sand mining needs to be done.

- The software for the computer simulations of wave actions on the beaches will have to be obtained and personnel trained in its use. Computer simulations should be conducted before the construction of any jetty. These should be carried out for all existing jetties so that modifications can be made to minimise beach erosion.
- Environmental Impact Assessments of all development activities have to be made mandatory, and a strong EIA Cell should be set up immediately with mandatory powers, that includes non-official members. The Supreme Court in its recent orders has ordered that all development projects have to be sanctioned only after EIA is carried out by a MoEF approved agency.
- Import of river sand from mainland can also be attempted as not much sand is required now with likely future reductions. The recommendations of Shekhar Singh Commission are to use only treated timber in all future constructions and to switch over to "Assam type" constructions suitable for such seismic zones. Sand mining should also be reduced, in view of the Supreme Court order.

Research priorities:

- *Extent of beach loss:* The beach loss and the loss of coastal forest have been obvious. What is not known is the extent of erosion. Obtaining maps from the 1950's, and using a GPS to plot the current coastline at selected sites can estimate the extent of the loss of beaches. Since beach loss is a major cause of concern within these islands, this activity also becomes high priority.
- *Floating barriers:* Floating barriers consisting of used car tyres have been utilized in the USA to build up beaches with considerable success. Experiments need to be carried out here to establish the feasibility of this approach.

- *Tidal flows near jetties:* This information will have to be gathered for each jetty to use as inputs for the simulations. These data will then be used to make design modifications to jetties.

9. 4. Impact assessment of fishing on biodiversity

What is known?

There has been a reduction in number, and a reduction in the mean size of individuals caught. The catch per unit effort appears to have declined, though there is no data to back this up. Large sizes in groupers, sharks, lobsters and crabs have become rare, and sea cucumbers are not commonly seen in shallow depths. The same applies for shells.

Actions to be taken:

- Increased monitoring of all kinds of fish catch. Improved enforcement of existing regulations, especially with regard to fishing by local residents.
- Monitoring needs to be done to ensure that the trawlers do not operate in coral bed areas which causes incalculable damage to the ecosystem.

Research priorities:

- *Catch per unit effort of different species:* It is not yet known what species are declining, and to what extent. A database needs to be set up and methodologies evolved to estimate catch per unit effort on a periodic basis. This needs to be done over a long term.
- *Alternatives for shell diving and trade:* The Industries Dept. estimates that 2000 persons are solely involved in the shell trade. The recent partial ban on shell collection is going to affect their livelihood adversely. At the same time it is necessary to protect a resource that is rapidly dwindled. The fishermen of Andaman and Nicobar Islands do traditional fishing. For example, they employ gill nets, hook & line, cast net, bag net and anchor net. Provision should be made in the Fisheries Act to ban shark fishing and to restrict, by closed seasons, the catches of groupers, lobsters and crabs to prevent

over exploitation. During the breeding periods, fishing should be closed.

9. 5. Impact assessment of agriculture on biodiversity

What is known?

A reduction in forest area has occurred because of increasing agricultural activity, and this has led to species loss, at present and in the future. Crop yields are declining, and this leads to increased dependence upon nearby forest, ocean resources and their eventual degradation. Since there is no proper quarantine at transit points, pests and diseases are being introduced in crops from mainland India.

Actions to be taken:

- Monitoring and control of encroachments: Since these are a consequence of immigration, steps to control immigration are also necessary.
- In-situ and ex-situ conservation of wild relatives of cultivated species.
- Development of cooperatives for marketing.
- Creation of cold storage facilities.
- Increase in number of well-trained development personnel.
- Better transport facilities.
- Information network.
- Control of soil erosion.
- Reclamation of saline land.
- Creation of additional facilities for irrigation and construction of ponds and sunken wells.
- Establishment of quarantine facilities.

The following are not directly related to biodiversity conservation and are not discussed in detail: demonstration of multi-cropping in the Nicobars; introduction of organic farming, orchid cultivation and floriculture; value addition to coconut and areca nut; spice cultivation and extraction of oils (cinnamon, pepper, cloves, and ginger); small scale rural industries, like those developed by CSIR.

Summary of Research priorities:

- *Avifaunal change with pesticide use:* Pesticides have been implicated, both in mainland India and elsewhere, for a loss in bird and insect diversities. An as-

essment of how species diversity in the Andaman & Nicobar Islands has been affected needs to be carried out to understand whether it is necessary to phase out pesticides.

- *Agricultural production in the Nicobars:* Agriculture in the Nicobars has been hit by ageing coconut plantations as well as dropping copra prices. Research is required both from a sociological viewpoint (on how plantation productivity can be enhanced) and from an economic point of view, to establish what value addition can be done in the Nicobars. Also relevant is to establish whether the Nicobari methods of farming coconut and areca nut are in fact more productive than those used elsewhere.
- *Agro forestry alternatives to agriculture:* Declining crop yields will necessitate shift in land use for agriculture to agro forestry in a significant proportion of the cropped area. Research and development of agro forestry operations therefore needs to be done on a priority basis.
- *Protect from of crab-eating macaques:* Crab-eating macaques are a major problem in coconut plantations, especially on Great Nicobar Island. It is required to experiment with techniques to prevent the animals from damaging coconuts and other crops.
- *Identify encroachments using satellite imagery:* Rapid identification of areas that have been encroached is extremely important in reducing their occurrence. New satellite imagery technology makes it possible to identify land use changes over extremely small areas. These need to be integrated into the functioning of the Forest and Revenue Departments.

9. 6. Impact assessment of introduced domestic species

What is known?

Grazing by domestic animal species is already causing degradation in forest areas.

Seven species have gone feral in the Nicobars after the tsunami and this is of a major concern. This can cause long term effects on local fauna and flora, mainly on Great Nicobar Island.

Actions to be taken:

- Incentives have to be created for stall-feeding. These could involve upgrading cattle breeds with high milk yields, and prevention of free-range grazing.
- Planting of fodder trees, together with dairying and value addition such as cheese production need to be introduced on a professional level.
- Strict enforcement is necessary to ensure that animals do not graze in forest areas, especially in the tribal reserves.
- Reducing the quantity of livestock by improving quality.
- Urgently formulated action plans and immediately implemented for removal of domestic pigs, goats, cows, dogs, cats and chickens that have become feral after the tsunami in the Nicobar Islands and mainly on Great Nicobar Island. Cows, goats and pig can be caught and handed over to settlers and to the Nicobare people. The Nicobare people, who have already started to collect some of their animals (Chandi, per. com), and the settlers can be given this responsibility as an income generation option.

Research priorities:

- *'Carrying capacity' studies:* The daily requirement for milk in the islands is not known. The total requirement of draught animals for farming is not known. The requirement of meat from goats is not known. Research aimed at gathering this information will allow policies to limit livestock to be implemented.

9. 7. Impact of medicinal plants

What is known?

Every tribal group in the islands has a rich ethno botanical tradition, but most of these traditions are not well documented. Some groups from mainland India, such as those from Chota Nagpur, have developed their

own medicines using endemic plants, over the last fifty years (Appendix 16). The Karen in Middle Andamans have their own plant-based medical system based on knowledge brought from Myanmar. MNC pharmaceutical companies have been prospecting for plants with medicinal values over the rest of India, and it is entirely likely that this has been happening and/or will soon be happening in the Andamans as well.

Actions to be taken:

- Steps need to be taken immediately to ensure that any medicine that is obtained from traditional tribal knowledge is patented in the name of the tribe, and a mechanism must be set up to ensure that the benefits go to the tribe.
- Checks at the airport and ports must be extended to plant materials as well.

Research priorities:

- *More information:* The work on ethno botany being carried out now needs to be considerably expanded in scope.
- *Species information:* After collection, identification and processing in a herbarium of a species of medicinal value, research will have to be done on its propagation, its phytochemical and pharmacological properties, and its conservation.

9. 8. Impact of wild relatives of cultivars

What is known?

Wild relatives of many of the cultivated plants exist in the forests of ANI, such as wild rice, wild areca nut, wild betel leaf, wild ginger, wild turmeric and wild nutmeg.

Actions to be taken:

- Botanical surveys have to be conducted to identify the distribution of the wild relatives of cultivars.
- The wild relatives of cultivars are required to be assembled in a germplasm bank.
- They are required to be characterized in terms of their growth characteristics as well as special genetic qualities, such as, resistance to pests and diseases, toler-

ance to physico-chemical stress in the environment.

Research priorities:

- *Systematic experimentation:* Studies to improve cultivars using wild relatives should be undertaken through conventional and non-conventional breeding techniques.

9. 9. Encroachments and their impact on biodiversity:

What is known?

About 4000 ha of forest land is under encroachment. This has caused fragmentation of the forests and disturbance to the flora and fauna.

Actions to be taken:

- A GIS Cell already exists with the Forest Department. Satellite data must be used for immediate identification of fresh encroachments and their eviction.

Research priorities:

- *Development of GIS methodology:* A methodology suited to these islands to identify encroachments based on satellite imagery needs to be developed and implemented.
- *Training:* FD staff requires training in the use of GIS. Field staffs require training in the use of GPS to quickly and accurately locate and map problem areas.

9. 10. Assessment of resource use by different communities and their impact

What is known?

Until now, attempts to bring tribal groups, excluding the Nicobarese, into the mainstream have led to declining populations, the threat of extinction for some.

Actions to be taken:

- The welfare programmes for the tribals to be undertaken in future, will depend on the policy recently formulated by the Govt. of India in consultation with the experts.
- The policy lays down that the traditional knowledge of Jarawas including ethno-

medicine shall be preserved and documented.

- The policy also aims at codification of the Jarawa language, so that communication with them becomes easy.
- The natural resources within the tribal reserves shall be left intact for the exclusive use of the aboriginal tribes and no extraction of any natural resource shall be undertaken by the Administration.

Research priorities:

- *Human ecology of all the indigenous groups:* The population dynamics, foraging patterns, nutrition and behavioural patterns of all these tribal groups are understood at a very superficial level. Intensive studies need to be initiated in all these aspects.
- *Use of medicinal plants:* There are many new medicines to be discovered by studying the ethno botany of the different tribal groups. These need to be documented, tested and then patented in the name of the tribal community involved. The implications of doing this needs to be considered carefully in advance, since an inflow of plant collectors into the tribal reserves would be undesirable.

9. 11. Assessment of immigration patterns and impact of demographic pressures

What is known?

Increased immigration has led to increasing agricultural activity. Such activity leads to encroachments, resulting in soil loss, loss of productivity and damage to coral reefs.

Actions to be taken:

- Comprehensive steps have to be taken to prevent further influx into the islands. These can include removing the subsidy on ship fares for non-locals, and introduction of regulation to restrict entry into and residence in these islands.

Research priorities:

- *Population projections:* Using different scenarios of immigration, these would

help in proper planning for infrastructure development.

- *Reasons for immigration:* We do know, to an extent, what has attracted the inflow of people from mainland India. Increased and better business opportunities, higher wages and easy availability of land for encroachment contribute to immigration. We do not know where they come from (except for region), the reasons they chose to come here and the employment they get here. We also do not know the role subsidies play in this. Detailed interviews with persons who have come here in the last decade are expected to throw light on this and enable the Administration to come up with measures to control further inflow.
- *Impact of human activities:* In general, the impact of human activities on coral reefs, wetlands and rainforest ecosystems and mangroves needs to be studied.

9. 12. Assessment of mangroves

What is known?

Degradation and loss of mangroves is taking place in some areas because of encroachments and cutting for domestic use.

Due to the subsistence of the southern portion of South Andaman Island, large tracts of mangroves have been destroyed.

Actions to be taken:

- Changing the status of mangroves in Protected Forests to Reserve Forests is necessary for effective protection.
- Satellite imagery combined with ground truth is an urgent need to enable the delineation of all mangrove areas.
- In revenue areas, wherever the mangroves are still intact, they should either be converted into forest areas with due compensation or be preserved in the revenue area itself for ecological purposes and for tourism.

Research priorities:

- *Mangrove monitoring:* A network to monitor mangroves needs to be estab-

lished using the guidelines lay down by IUCN and GCRMN. This will allow tracking of changes in different areas over a period of time.

- *Mangrove fauna:* While samples of mangrove fauna have been collected at several sites, many other sites, especially in the Nicobars, remain unsurveyed for their fauna. The fauna for several localities, and their associations with particular mangrove species, need to be worked out.

9. 13. Assessment of coastal ecosystems

What is known?

Beach erosion has occurred and is occurring because of sand mining. The ANI have lost 21 marine turtle nesting beaches between 1981 and 2000 due to sand mining (Andrews et al, 2001d). The ANI has over 100 sea turtle nesting sites for four species (Appendix 17). Areas north of South Andaman Island in the Shole Bay area, intrusion of the sea occurred by 1997. Mainly due to sand mining, and this led to erosion of beach forest destroying 100s of trees and intrusion of sea water into agricultural lands (Singh, 1997; Ali et al., 2002). Since some areas of littoral forests are falling in revenue area, there is very little check on felling and lighting fires, and encroachments.

Due to the subsidence of the Nicobars most all coastal ecosystems have been destroyed.

Actions to be taken:

- Steps need to be taken to include the littoral forests in revenue area in Reserve Forests. Pulverised granite has to be introduced immediately as a substitute for sand.
- Due to the impacts of the tsunami, no major management or conservation effort is required for the Andaman and Nicobar Islands. Planting and restoration programmes are currently not required. It must be remembered that mangroves, and *casuarina* plantations do not protect from tsunamis. There are

other native littoral species (other than *Casuarina*) that can be used to reduce erosion along coast. Monitoring of the natural mangrove regeneration and the inland wetland habitats are required for the next three years, at least, to conclude status and permanent changes that will occur.

- Further land surveys are required with the aid of GPS for ground truthing and GIS to derive the actual extent of beach and reef flat loss, besides remapping the entire Andaman and Nicobar Islands and its topography
- There is a need, in the Nicobars, for extensive planting of *Pandanus nico-barensis*, which occurs in the Nicobars, and this species grows very fast. As for *Nypa fruticans*, seeds and seedling can be collected from the Andamans and this species has been very successfully propagated from seeds at ANET base. However planting of these species can be taken up only after the 2005- 2006 monsoon seasons. This will involve intensive surveys and assessments of islands and areas for planting and in consultation with the Nicobarese people for their opinions and recommendations as this will be very important.
- The sea turtle beaches that have been affected will start to re-form after 2005 monsoons and other new beaches will also build up in another two to three years time and this will require monitoring as marine turtles will find new nesting islands and beaches.

Research priorities:

- *Inventing avifauna*: Studies on migratory species, monitoring megapode in the Nicobars.
- *Inventing herpetofauna*: Studies on sea snakes, lizards and amphibians.
- *Monitoring marine turtle nesting*: Continuation of ongoing studies and surveys.
- *Inventing small mammals*: Intensive studies on two species of tree shrews in Great and Little Nicobar Islands.

9. 14. Assessment of wetlands

What is known:

These have been drained for agriculture and development activities, mainly those that are close to and around urban areas. Swamp forest is rare now and is found only in PAs. They harbour a number of endangered and endemic species such as Andaman teal, crocodiles, freshwater fish and Andaman crane, besides other migratory wetland birds.

Actions to be taken:

- Protection of all wetland areas that have already been identified is urgently required.
- Routine monitoring of pesticides in these wetlands is also necessary, besides controlling poaching and fishing.

Research priorities:

- *Identification and mapping of wetlands*: All the open wetlands in the islands need to be identified using remote sensing methods. These should then be surveyed and areas identified should be integrated into the protected area network.
- *Ecological studies*: Studies to be undertaken of the ecology of select wetlands and their associated species. This would have to be a multidisciplinary approach and effort.

9. 15. Assessment of coral reefs

What is known:

The area of coral reefs in the Andaman and Nicobar Islands exceeds the land area, and is being damaged due to a number of factors including siltation, trawling, dynamite fishing, tourism and anchor damage.

Actions to be taken:

- Establishment of new marine national park off the East and West coast of Middle and North Andamans Islands.

Research priorities:

- *Assessment of extent and diversity of coral reefs*: The species diversity of corals, reef extent and fishes at different depths in different areas needs to be studied in much greater detail to deter-

mine which areas should be protected in the future.

- Assessment of the impact of fisheries, fertilisers, siltation and pesticides on coral reefs is required.

9. 16. Assessment of medicinal plants

What is known?

All island indigenous groups have a rich ethno-botanical tradition, that has largely not been documented. Some groups from mainland India, such as those from Chota Nagpur, have developed their own medicines using island endemic plants, over the last 50 years. The Karens in Middle Andamans have their own plant based medicine system based on knowledge brought from Myanmar. MNC pharmaceutical companies have been prospecting for plants with medicinal values over the rest of India, and it is entirely likely that this has been happening in Andamans as well.

Actions to be taken:

- Steps need to be taken immediately to ensure that any medicine that is obtained from traditional tribal knowledge is patented in the name of the tribe, and a mechanism must be set up to ensure that the benefits go to the tribe.
- Checks at the airport and ports must be extended to plant materials as well.

Research priorities:

More information: The work on ethno-botany being carried out now needs to be considerably expanded in scope. Species information: after collection, identification and processing in a herbarium of a species of medicinal value. Research will have to be done on its propagation, its phytochemical and pharmacological properties, and its conservation.

9. 17. Assessment of wild relatives of cultivars

What is known?

Some information is available on wild nutmeg, turmeric, wild ginger and few others, and

there is no scientific information on these, although they are known to occur in the islands.

Actions to be taken:

These need to be identified and studied.

Research priorities:

Systematic experimentation to improve cultivars using wild counterparts should be undertaken.

9. 18. Trade in wildlife species and foreign poaching in coastal waters

What is known?

There is information on smuggling of coral, crocodile skins, shells, sea cucumbers, turtle carapaces, deer antlers and skin and edible nest swiftlet nests; both through local airports and seaports, and by foreign poachers operating here.

Actions to be taken:

- Forest Dept. staff has to be involved with the security checks at the airport and the harbour. Increased staff at the ports is also required, who will conduct checks.
- Improved patrolling on reef areas and along the coast of ANI.

9. 19. Social forestry and JFM

What is known?

There has been no attempt at JFM in the Andamans as no necessity was felt. Further the models of JFM adopted in mainland are not workable here.

Actions to be taken:

- JFM for a limited purpose of Joint Forest Protection can be tried on an experimental basis at three or four sites where the forest is highly vulnerable.
- Social forestry can be taken up on all cleared land that is taken over after the eviction of encroachers on forest and revenue land.

Research priorities:

- *Tree improvement:* Techniques have to be developed for improving the quality of trees to be planted on degraded land, through conventional tree breeding by clonal seed orchards, seedling seed orchards and seed production areas of the

desired tree species. The advantage of these trees is an improved yield reducing dependence on forest resources; the disadvantage is a lower genetic diversity, eliminating this as an option for planting in forest areas reserved for protection.

9. 20. Protected areas management

What is known?

There are 96 wildlife sanctuaries and 6 National Parks notified under the Wildlife (Protection) Act, 1972 (Appendix 18). Besides one Biosphere Reserve and recently 26 areas have been identified as IBAs in ANI (Appendix 19).

Actions to be taken:

- Demarcation of boundaries of all PAs.
- Notification of all proposed extensions and buffer zones.
- Improved equipment and communication system for all forest staff.
- More fast boats and vehicles to facilitate patrolling.
- Coastline, coral reefs, sea grass beds and other marine ecosystem monitoring and management.
- Management plans for PAs, wetlands, coral reefs, crocodiles and marine turtles.
- Since IBA areas have been identified, these areas now require notification and protection and should be done as soon as possible. Protection generally needs to be enhanced with increased staff and facilities such as boats.
- Reorganisation of certain smaller PAs as proposed by WII, IIPA, BSI and ANET, so as to make their boundaries ecologically sound and accord them effective protection and management.
- Arboreta and proper interpretation centres should be set up in each important protected area for public educational purposes.
- Removal of introduced deer, dogs, cats and elephants.
- Joint patrolling by co-ordination between Forest Department, Police, Coastguard and the Navy.

Research priorities:

- *Mapping of vegetation types:* A combination of high-resolution satellite imagery combined with ground truthing will enable this. First level information has already been provided by the study on Biodiversity Characterization at landscape level conducted by the Department of Space, GOI and the Department of Environment & Forests.
- *Identification of Key-stones:* The above exercise has provided information on both the areas of biological richness and areas of disturbance, which will help in deciding what areas need to be added to the protected areas network. These areas will then have to be surveyed to find out their suitability for inclusion into the PA network. The identification of wildlife corridors to facilitate the movement of identified animal species, marine and terrestrial, would also be part of this.
- *Mapping of coral reef areas:* The extent of coral reefs in A & N has been variously estimated using satellite imagery. Satellite imagery can be used in the preliminary stages, but since its accuracy in mapping reefs is not very clear, intensive physical verification will be required.
- *Preparation of management plans:* Management plans exist only for Mount Harriet National Park and MGMNP, and need updating and revision. Management plans need to be drawn up urgently for all the other protected areas in the islands.
- *Mangrove ecosystems:* The threats to mangrove ecosystems, as well as the dynamics of these systems, are poorly understood. Five sites need to be selected in the Andamans and monitored on a long-term basis to understand the threats. At the same time studies on nutrient cycling and associated fauna of the mangroves should be initiated.

9. 21. Areas to be added to PA network

What is known?

Wetlands and marine areas are not adequately covered.

Actions to be taken:

The following areas are to be considered for addition to the PA network:

In the Andamans

- MGMNP to be expanded by including entire Rutland, the two Twins and the two Cinque Islands.
- Inclusion of Nicholson, Peel, Wilson, Inglis, North, Middle and South Button Islands; this is critical for dugong habitat/ sea grass ecosystem and the high diversity of corals in the reef areas around this entire area, and in the existing Rani Jhansi MNP (Andrews & Sankaran, 2002; Ali, et al., 2002).
- Designation
- Little Andaman Island, a complete ecological survey including coral reefs is urgently required; the wetlands (Fresh-water marshes, peat bogs and fresh-water streams) are unlike any found in the Andamans or Nicobars. This island is the last strong hold for the Andaman teal and other wetland birds, wild pig, crocodile and the leatherback sea turtle (Andrews, 2000; Andrews & Sankaran 2002).
- A new marine national park to include South Reef, Mask, Anderson, Interview, Roper, Ranger, Bennet, Surat, Snake, Sea serpent, Boundeville Entrance, North Reef, Lotouche and Snark Islands, including the seas around.
- Kadakachang Wetland- Little is known about this habitat.
- Hanspuri wetland- Important habitat for Andaman teal and the Andaman crane.
- Extension of Cuthbert Bay Turtle Sanctuary along the existing beach on the south and north right up to Phoenix Point and adjacent vegetation fringe on the landward side (Andrews, et al., 2002).
- Mount Diavolo as a protected area.

In the Nicobars

- Central and uninhabited coastal areas of Little Nicobar
- Galathea/South Bay in Great Nicobar Island
- Part of Kamorta
- Grasslands on Teresa & Bompoka

9. 22. Enumeration of biodiversity

What is known:

The BSI and ZSI have carried out extensive surveys of all the major taxa. There are, however, gaps in this. Coral reefs, small mammals, fresh water fish and herpetofauna are a major gap, and every survey finds new records and new species.

Research priorities:

- *Ecosystem/Habitat Survey:* Proper surveys need to be conducted on each of the existing and proposed PAs.
- *Surveys of key taxa:* Amphibians, birds and butterflies are key indicators of the habitat of any place. An island-wise survey for these, and of the flora, will enable understanding of the biogeography of these islands.
- *Small mammal survey:* There are very high diversities in bats and rodents in these islands, and many of the species are endemic. There is also likelihood that there are several undescribed species. A systematic effort to collect and identify specimens of these across both the island groups is necessary.
- *Fossil information:* There is no information on the original fauna of these islands since no effort has been made to collect fossil material. The recent excavation to prepare the new airport presented an opportunity to collect fossils that was not realized. Fossil material will facilitate the determination of what evolutionary processes occurred in the ANI.
- Delineating critical endemic bird areas and their status (BNHS)
- Delineating important areas for herpetofauna and status surveys (ANET).
- Delineating important areas of endemic plant diversity (BSI, AN DE & F).
- Management of Tribal Reserves (AN DE & F).

9. 23. Threats to particular taxa

What is known:

The BSI, ZSI, SACON and ANET have carried out extensive studies in some of the

major taxa. Examples: Sreekumar (2002) and World Conservation Monitoring Center (WCMC, 1994) have reported 82 species of flora as rare, endangered and threatened (Appendix 20). Others include shells, avifauna and herpetofauna.

Actions to be taken:

- Continuous monitoring and removal of goats from Narcondam and Barren Islands is needed; so is a large-scale implementation of swiftlet farming and more protection for megapode habitat along the south east coast of Great Nicobar Island.
- Small PA's for particularly rare and endangered species, such as *Euphorbia epiphyllodes* found only on Saddle Peak, Munda Pahar and at Kalpong, should be created.
- Large reptiles, saltwater crocodile and marine turtles, need urgent conservation and management action.

Research priorities:

- *Restricted range species:* Surveys should be conducted on other endemic bird species to establish their current status and threats.
- *Surveys of threatened species:*
 - Cetacean diversity
 - Sharks
 - Whales
 - Dugong surveys/status
 - Coral reefs
 - Endemic birds
 - Endemic reptiles
 - Endemic plants
 - Marine turtles
 - Crocodile
 - Giant robber crab
 - Nicobar tree shrews

9. 24. Introduced species

What is known?

Introduced species include chital, barking deer, elephants, dogs, cats, rats, crows and mynahs. Browsing by elephant on Interview Island, and by chital and barking deer in the Andamans is affecting forest regeneration and in the Natural Regeneration Areas and is

likely to lead to loss of species diversity in the future.

Actions to be taken:

- Interview Island has about 35 elephants. The problem needs to be controlled.
- An amendment of the Wildlife (Protection) Act, for the culling and removal of deer is necessary.
- Eradication and removal of invasive plants.

Research priorities:

- *Enclosure experiments:* It has been established that browsing by spotted deer affects regeneration. It is not clear as to which species are preferred browsing and what the long-term effects of this browsing will be. Fencing off areas and comparing these with browsed areas, in both natural forest and natural regeneration areas will enable a determination of the long-term consequences of browsing.
- *Environmental impacts:* Very little is known about the impacts that dogs, cats, squirrels and mynahs (all introduced) have on the environment. Research needs to be done on these introduced species, with particular reference to removal strategies.

9. 25. Alternative renewables

What is known?

In every field of human enterprise there are alternatives that are environmentally friendly. These include:

- Alternative energy such as solar, tide and wind, ideally suited for the ANI. (Electricity Dept.)
- Alternative construction materials such as pulverised granite, treated wood. (APWD)
- Water conservation and rain water harvesting as an alternative to large storage structures; (APWD, DRDA)
- Bio pesticides as alternatives to the highly toxic inorganic pesticides available in the market; (Agriculture)
- Cash crops with value addition as an alternative to paddy, which is damaging the

environment due to runoff, soil loss, siltation on coral reefs (Agriculture, Forestry)

- The development of ecotourism (IPT, Forestry)

Actions to be taken:

- The concerned departments, as above, to give these priority in their annual and 5-year plans.

Research priorities:

- Feasibility studies on alternative energy from solar, tidal and wind.
- Assessment of different rainwater harvesting methods.
- Research on contained high value agriculture.

9. 26. Awareness generation

What is known?

ANI has 344 schools and five colleges that include a Teacher Training Institute, a B.Ed college, two polytechnics, two Degree colleges and an Industrial Training Institute, spread over 36 islands.

- Information and teaching is more science or geography oriented rather than Environment related.
- Lower number of environmental concepts in Classes X and XII.
- Environmental concepts are not integrated across subjects.
- There is a major gap due to the absence of local specific information on forests, coral reefs, understanding sustainable development, island ecology, species richness and endemism.
- Kalpavriksh and ANET have produced an environmental handbook for teachers 'Treasured Islands' in Hindi and English.

Actions to be taken:

- Awareness generation programmes need to be initiated in all aspects of biodiversity conservation. Programmes should be specifically designed for each stakeholder group.
- A study to evaluate the present status of teaching methods used by teachers to impart environment education.
- Linkages to school curricula through Teachers Training initiatives and Work-

shops to link non-formal environmental education technologies into mainstream formal educational processes.

- Of special relevance is the introduction of an environmental component in the schools, at all levels. This environmental component must be specific to these islands.
- Awareness generation programmes are also necessary for tour operators, fishermen and other stakeholder groups. A start was made in this direction in the MGMNP, involving both the AN DE & F and ANET.
- A mechanism needs to be evolved by which environmentally relevant details can be supplied to the relevant decision makers on a rapid basis, and environmental inputs become part of any development planning process.

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11. Action plan

11. 1. Agriculture

11. 1. 1. Control of forest encroachments for agriculture

Actions being taken	<ul style="list-style-type: none"> • Clearing of encroachments in areas that have been encroached after 1978. • Schemes to rehabilitate encroachers. • Rehabilitation of degraded lands after all evictions are completed.
Implementing agencies	Forest Dept., Revenue Dept. Industries Dept., Education Dept.
Time frame and proposed time of start	Immediate- Priority : URGENT
Rationale	Eco-restoration of degraded lands following order of Supreme Court.
Key methods	<ol style="list-style-type: none"> 1. Identification of land for resettlement (Revenue Dept.) 2. Shifting & Relocation (Dept. Environment and Forests, Revenue Dept.) 3. Identification and training for alternate employment (Industries) 4. Nursery work and planting of degraded land (DEF) 5. Control for reducing immigration; elimination of transport subsidies.
Fund requirement and source	Rs. 40 crores (approx.)
Integration with other programmes/ plans	Industries Dept & Tourism Dept. to play major supporting role.
Conflict resolution	Marginal decrease in agricultural productivity, increase in unemployment.

11.1. 2. In-situ and ex-situ conservation of wild relatives of cultivated species

Actions to be taken	<ul style="list-style-type: none"> • Identification of areas where wild relatives of cultivated species are found. • Identification of mother trees • Protection measures for areas found, if necessary. • Seed collection and propagation at key sites
Implementing agencies	Forest department (in-situ conservation) Agriculture Dept. CARI
Time frame and proposed time of start	5 years, ongoing Start: 2005.
Rationale	Germplasm of wild relatives for genetic improvement of cultivars.
Key methods	Survey, land allocation, nursery practice, plantation.
Fund requirement and source	5 lakhs annually
Integration with other programmes/ plans	Employment for nursery and watch and ward staff through DRDA.
Conflict resolution	NIL

11. 1. 3. Cooperatives for transport, marketing and enhanced productivity

Actions to be taken	<ul style="list-style-type: none"> • Formation of cooperatives (Coop Dept., NGOs) • Deep freeze, cold storage at key spots (Industries, Fisheries & Agri. Depts.) • Arrangement of better transport (STS, Marine) • Arrangement of training for extension personnel
Implementing agencies	Agriculture Dept., Fisheries Dept., JNRM (Commerce & Cooperative Management Departments)
Time frame and proposed time of start	2 years for set up Start: 2005.
Rationale	To enhance income opportunities for farmers and fishermen
Key methods	Arranging finance, P.R.A's, negotiations, supervision of construction
Fund requirement and source	30 lakhs A & N Administration
Integration with other programmes/ plans	Fisheries face storage and transport problems
Conflict resolution	Existing middlemen likely to create problems.

11. 1. 4. Introduction of organic farming.

Actions to be taken	<ul style="list-style-type: none"> • Establishment of demonstration farms (Agri. Dept. & CARI) • Identification of farmers willing to grow organic crops (Agri., NGO) • Training and facilitation of above (NGO) • Arranging marketing linkages (Agri, NGO) • Demonstrating advantages of organically grown food (CARI)
Implementing agencies	Agri. Dept., CARI, NGO's
Time frame and proposed time of start	5 years starting June 2006.
Rationale	Reduction of pesticide use, improved health, protection of coral reefs.
Key methods	Demonstration & Training
Fund requirement and source	15 lakhs annually
Integration with other programmes/ plans	Coordination with agency pollution/pesticide monitoring.
Conflict resolution	NIL

11.1.5. Orchid cultivation and floriculture

Actions to be taken	<ul style="list-style-type: none"> • Collection of wild plants from forestry operations are to occur. • Roadside collection during monsoons from windblown trees. • Establishment of nursery and demonstration plots • Training and supply of material to select farmers • Obtaining and distribution of hybrids
Implementing agencies	CARI, BSI & ANET, JNRM (Botany Department)
Time frame and proposed time of start	5 years June 2005
Rationale	Orchids are a sustainable, income generation resource
Key methods	Appropriate nursery techniques to be taught, tissue culture laboratory to be set up, seed flasks to be imported.
Fund requirement and source	20 lakhs annually From: MOEF
Integration with other programmes/ plans	Forest dept. to permit collection for propagation from private land and roads.
Conflict resolution	Forest Dept. to monitor, to ensure that material collected from the wild does not leave the islands. NB: Smuggling of genetic material likely to occur even if this programme does not exist.

11. 1. 6. Water management for agriculture and household use.

Actions to be taken	<ul style="list-style-type: none"> • Construction of structures to prevent runoff and soil erosion. • Reclamation of saline land of low biodiversity. • Planting trees on degraded hill slopes and along streams. • Creation of check dams and protection of catchments. • Construction of household rainwater harvest structures. • Construction of open ponds. • Establishment of management mechanisms for above at village level.
Implementing agency	Agri. Dept (Know-how), PWD, DRDA, Village panchayats & NGO
Time frame and proposed time of start	3 years for pilot in Wandoor & Manglutan panchayats June 2005
Rationale	Enhance agriculture, reduce water scarcity, protect catchments
Key methods	Mapping through GPS and GIS, construction, P.R.A's to organize.
Fund requirement and source	50 lakhs annually
Integration with other programmes/ plans	Will meet drinking and domestic water needs also.
Conflict resolution	Restrictions on livestock movement in catchments.

11.1.7. Establishment of quarantine facilities

Actions to be taken	<ul style="list-style-type: none"> • Facilities for isolation and fumigation of plants and animals coming into the islands • Training and posting personnel at both airport and seaport • Monitoring of disease and pest outbreaks and providing solutions.
Implementing agency	Agriculture Dept., AH & VS, CARI (monitoring)
Time frame and proposed time of start	Ongoing, urgent and immediate
Rationale	To prevent new diseases of plants and animals entering the islands.
Key methods	By establishing facilities and operating them by researching pest outbreaks, to ensure that exotic species are not introduced.
Fund requirement and source	50 lakhs establishment 10 lakhs annually
Integration with other programmes/ plans	Silviculture Division of Forest Dept., ICFRE for plant pests, IVRI.
Conflict resolution	NIL

11.1.8. Wild relatives of cultivars

Actions to be taken	<ul style="list-style-type: none"> • To map the distribution of wild relatives of cultivars • To undertake genetic typing of wild relatives of cultivars • To determine conservation status /efforts, in-situ and ex-situ • To identify desirable traits and incorporate into cultivars
Implementing agency	BSI & CARI
Time frame and proposed time of start	June 2006 5 years
Rationale	Wild relatives of: ginger, nutmeg, betel, mango, rice and banana, besides several other fruits and tubers in ANI. The germplasm from wild cultivars need immediate protection at the earliest.
Key methods	Survey, collection, propagation, nursery/ laboratory and field research
Fund requirement and source	20 lakhs annually.
Integration with other programmes/ plans	Dept. of E & F for monitoring and Agriculture dept. can carry out extension work.
Conflict resolution	NIL

11. 1. 9. Avifaunal change with pesticide use

Actions to be taken	<ul style="list-style-type: none"> • Analysis of pesticide residues in birds in various areas • Determination of pesticide use, and bird community composition.
Implementing agency	SACON and ANET (field surveys), CARI (residue analysis)
Time frame and proposed time of start	June 2006, URGENT 3 Years
Rationale	Elsewhere, pesticide use linked to loss in bird diversity, including species feeding on pests. Research on problem and solutions needed urgently.
Key methods	Survey and census; laboratory assays.
Fund requirement and source	40 lakhs over 3 years
Integration with other programmes/ plans	Agri. Dept. for providing information on pesticide use patterns. JNRM student projects can be done as part of this.
Conflict resolution	NIL

11. 1. 10. Agroforestry alternatives to agriculture.

Actions to be taken	<ul style="list-style-type: none"> • To initiate plots of cane, bamboo, fuel, fodder, timber on existing agricultural land • To monitor to establish economic viability • To carry out extension activity where economically feasible.
Implementing agency	Dept of E & F, NGO's
Time frame and proposed time of start	September 2006 2 years to initiate Phase 1; monitoring/ extension ongoing
Rationale	Declining crop yields will necessitate shift in land use for agriculture to agroforestry in a significant proportion of the cropped area.
Key methods	Nursery, plantation, monitoring, extension
Fund requirement and source	100 lakhs to initiate 5 sites; 10 lakhs annually for monitoring and incentives.
Integration with other programmes/ plans	Agri dept. - identification of areas where yields have declined most. Silviculture Division of Forest dept. for design and trial. JRMN to provide students to conduct research
Conflict resolution	Failure of alternatives and/or natural disasters to be countered with cash incentives if necessary.

11. 2. Tourism

11. 2. 1. Involvement of local residents in tourism development

Actions to be taken	<ul style="list-style-type: none"> • Establishment of extension cell in IPT for tourism information • Involvement of local residents in existing tourism operations • Involvement of local residents in proposed tourism developments.
Implementing agency	IP & T, JNRM (Tourism Department)
Time frame and proposed time of start	Immediate, ongoing
Rationale	Residents in tourism areas should have opportunities to benefit, to deter activities that degrade environment.
Key methods	Establishment of cell; Meetings with Panchayat by IPT; identification of activities related to tourism; training programmes for guides, lifeguards & boatmen.
Fund requirement and source	Initial: 20 lakhs; ongoing 10 lakhs/yr Outlay to be built into each new project
Integration with other programmes/ plans	Wildlife Wing of the Dept of E & F, Dept. Industries & Panchayats
Conflict resolution	NIL

11. 2. 2. Awareness in and around protected areas

Actions to be taken	<ul style="list-style-type: none"> • Increasing awareness of tourists in wilderness protected areas. • Education of students/teachers in protected areas.
Implementing agency	IPT, Forest Dept.
Time frame and proposed time of start	1 year; Immediate
Rationale	Unaware tourists may litter and/or damage corals.
Key methods	Establish interpretation centres at Mt. Harriet, Havelock I, Neil I; training programmes for guide & boatmen.
Fund requirement and source	15 lakhs, IPT
Integration with other programmes/ plans	
Conflict resolution	NIL

11. 2. 3. Elimination of subsidies for tourism

Actions to be taken	• Evaluation and elimination of tourist subsidies.
Implementing agency	Revenue Dept
Time frame and proposed time of start	August 2005 6 months
Rationale	Tourists receive up to Rs 10,000 in subsidies, including foreign visitors. Environmental "tax" would fund eco-tourism efforts.
Key methods	Research, imposition of tax/fare structures.
Fund requirement and source	4 lakhs for study
Integration with other programmes/ plans	Marine dept., SCI, Civil Supplies, STS.
Conflict resolution	Will temporarily lead to protests from foreign visitors. May temporarily lead to a drop in tourism. Tour operators will protest this in the short run.

11. 2. 4. Impact assessment at existing tourist sites

Actions to be taken	• Assessment of the impacts of tourism to date at Chidiyatapu, Wandoor, Mount Harriet National Park, Havelock, Kalipur, Mayabunder, and Little Andaman Island.
Implementing agency	IPT with NGO/ University
Time frame and proposed time of start	June 2005. 1 year
Rationale	Tourism impacts already obvious at many sites. These should documented and remedial efforts taken.
Key methods	Data collection and analysis. Interviews with key stakeholder groups such as Forest dept., tour operators, hoteliers, shopkeepers.
Fund requirement and source	3 lakhs Ministry of Tourism
Integration with other programmes/ plans	Forest Dept.
Conflict resolution	NIL

11. 2 . 5. Establishment of carrying capacity

Actions to be taken	<ul style="list-style-type: none"> • Determine bottlenecks and limiting factors in terms of food, accommodation, water resources and transportation in the islands. • Assess the extent to which these can be overcome without environmental degradation.
Implementing agency	NGO/ University
Time frame and proposed time of start	June 2005 1 year
Rationale	Increased tourism likely to lead to environmental degradation. WTO projects 155,000 tourists annually Tourism should be environmentally sustainable.
Key methods	Data collection and analysis
Fund requirement and source	5 lakhs
Integration with other programmes/ plans	Industries department- EIA cell to provide support.
Conflict resolution	NIL

11. 3. Animal husbandry and veterinary science projects

11. 3. 1. Keeping livestock out of forests.

Actions to be taken	<ul style="list-style-type: none"> • Upgrading to breeds of cattle with higher milk yields • Introducing dairying, cheese production and other value addition to milk. • Eliminating incentives for goat rearing near forest areas. • Growing of fodder trees on Panchayat land
Implementing agency	AH & VS, CARI
Time frame and proposed time of start	5 years, immediate
Rationale	Serious degradation to forests occurs with livestock entering it to browse.
Key methods	Schemes for stall feeding; no bank loans for goat rearing; penalties for goats in forest areas to be enforced.
Fund requirement and source	50 lakhs
Integration with other programmes/ plans	Forest Dept. to provide seedlings for fodder trees, to enforce non-entry of livestock.
Conflict resolution	Goat rearers will lose income and methods to compensate them for it will have to be worked out.

11.3.2. 'Livestock carrying capacity' studies.

Actions to be taken	<ul style="list-style-type: none"> • Survey of total milk consumption and estimation of trends • Survey of requirement of draught animals and estimation of trends • Survey of meat requirement and estimation of trends
Implementing agency	AII & VS, ANET, JNRM
Time frame and proposed time of start	2 years 2005
Rationale	Relevant unknowns at present include daily milk requirements in ANI, number of draught animals for farming, goat meat demand. These data needed for long-term planning.
Key methods	Questionnaires, survey, interviews.
Fund requirement and source	10 lakhs
Integration with other programmes/ plans	JNRM may use students for their thesis work.
Conflict resolution	NIL

11.3.3. Reducing the number of livestock by improving quality

Actions to be taken	<ul style="list-style-type: none"> • To reduce the number of livestock through improvement of quality.
Implementing agency	AH & VS
Time frame and proposed time of start	Ongoing
Rationale	To reduce pressure on the land by reducing the number of livestock.
Key methods	Import of frozen semen, use of AI methods, import of stud animals of superior breeds.
Fund requirement and source	Rs. 30,0000 A & N Admin.
Integration with other programmes/ plans	Forest Dept.
Conflict resolution	NIL

11. 3. 4. Breeding of local domesticated species

Actions to be taken	<ul style="list-style-type: none"> • Propagation of Nicobari Fowl • Propagation of Teressa Goat • Propagation of Nicobari Pigs
Implementing agency	AH & VS, CARI
Time frame and proposed time of start	Immediate, Ongoing
Rationale	Local domesticated species listed above better suited to island conditions
Key methods	Breeding and ongoing
Fund requirement and source	AH & VS
Integration with other programmes/ plans	With DRDA for income generation
Conflict resolution	NIL

11. 4. Introduced species

11. 4. 1. Control of spotted deer population

Actions to be taken	• Control of spotted deer, and feral dogs, including sterilization and culling.
Implementing agency	Dept. of Environment & Forests.
Time frame and proposed time of start	Immediate
Rationale	Chital population in the Andamans affecting forest regeneration.
Key methods	Sterilization, culling
Fund requirement and source	20 lakhs for pilot project MOEF
Integration with other programmes/ plans	Necessary to implement amendments in WLPA (1972) to authorize CWLW to order removal of animals exotic in a particular region, even if protected otherwise.
Conflict resolution	Objection from animal rights lobbies is anticipated. Awareness programme may be necessary.

11. 4. 2. Control of feral cats and dogs

Actions to be taken	<ul style="list-style-type: none"> • Licensing mechanism for dogs; establishment of pounds. • Formation of dog catcher and disposal squads. • Weapons for forest staff near sea turtle beaches.
Implementing agency	DEF; PBMC; panchayats.
Time frame and proposed time of start	Ongoing Immediate
Rationale	Dogs eat sea turtle eggs/adults. Cats threaten endemic birds.
Key methods	Trapping, removal
Fund requirement and source	30 lakhs establishment
Integration with other programmes/ plans	Coordination with Animal Welfare Board.
Conflict resolution	Problems with animal rights groups.

11. 4. 3. Assessment of impact of introduced Common Mynah

Actions to be taken	<ul style="list-style-type: none"> • Study of ecology and breeding biology of common mynah
Implementing agency	NGO /JNRM
Time frame and proposed time of start	3 years 2005
Rationale	This is an introduced species that has become extremely common. It may be competing with endemic birds for food resources and nest sites.
Key methods	Field research
Fund requirement and source	5 lakhs MOEF
Integration with other programmes/ plans	DEF to be informed about key findings for implementation if necessary.
Conflict resolution	NIL

11. 5. Native communities

11. 5. 1. Use of medicinal plants (Ethnobotany)

Actions to be taken	• To document the use of different plants by each tribal group
Implementing agency	BSI, NGO/ JRMN
Time frame and proposed time of start	2005 3 years
Rationale	Ethnobotanical studies likely will lead to new medicines to be documented, tested and patented for tribal benefit.
Key methods	Survey, collection of voucher specimens, interview, herbarium work
Fund requirement and source	40 lakhs MOEF
Integration with other programmes/ plans	CDRI to do assays of potentially useful plant substances BSI to do identification MOEF to monitor patenting.
Conflict resolution	NIL

11. 6. Immigration

11. 6. 1. Reducing influx into the Andaman Islands

Actions to be taken	• Reduce inflow of immigrants to ANI
Implementing agency	Revenue Dept.
Time frame and proposed time of start	1 year to implement Immediate
Rationale	Immigrants put undue pressure on natural resources, especially by employment and encroachments.
Key methods	Removal of the subsidy on ship fares for non-locals. Introduction of restricted area permits. Design and implementation of monitoring mechanism
Fund requirement and source	
Integration with other programmes/ plans	
Conflict resolution	NIL

11. 7. Research on taxa

11. 7. 1. Research on little known mammals

Actions to be taken	<ul style="list-style-type: none"> To survey little-known mammals island-wise Prepare island-wise check sheets of resident mammals
Implementing agency	NGOs/ JNRM
Time frame and proposed time of start	2005 3 years
Rationale	Endemic bats, shrews and rats based on incomplete surveys to date. Additional surveys, especially for these taxa.
Key methods	Survey, collection, literature search.
Fund requirement and source	40 lakhs
Integration with other programmes/ plans	Coordination with ZSI & ANET.
Conflict resolution	NIL

11. 7. 2. Extension of botanical surveys

Actions to be taken	<ul style="list-style-type: none"> To conduct botanical surveys of Tillanchong, Bompoka & Little Nicobar in the Nicobar group; Ritchie's Archipelago, and Cinque Island in the Andaman group.
Implementing agency	BSI
Time frame and proposed time of start	3 years 2005
Rationale	Botanical surveys of islands still incomplete. Additional surveys likely to lead to range extensions and/or new species.
Key methods	Survey, herbarium work
Fund requirement and source	30 lakhs
Integration with other programmes/ plans	Coordination with ongoing programmes involving research on medicinal plants and wild cultivars.
Conflict resolution	NIL

11.7. 3. Medicinal plants of Little Andaman

Actions to be taken	<ul style="list-style-type: none"> To collect, propagate and conduct tests on the medicinal plants of Little Andaman, as well as extend the knowledge of Onge ethno botany.
Implementing agency	BSI, CARI
Time frame and proposed time of start	3 years 2005

Rationale	Ethnobotany of Onges, Jarawas and Shompens needs additional attention with reference to medicinal plants.
Key methods	Survey, trials
Fund requirement and source	Min. of Health/ Medicinal Plants Board 50 lakhs
Integration with other programmes/ plans	CDRI, ICMR
Conflict resolution	NIL

11. 7. 4. Compilation of island-wise lists

Actions to be taken	<ul style="list-style-type: none"> To compile island wise lists of the flora of the islands using existing gathered material.
Implementing agency	BSI
Time frame and proposed time of start	Late 2005 6 months
Rationale	To understand island biogeography and to identify existing gaps.
Key methods	Literature review
Fund requirement and source	2 lakhs
Integration with other programmes/ plans	Will help in planning future surveys Can be done as thesis project by M.Sc. student from JNRM.
Conflict resolution	NIL

11. 7. 5. Mangrove epiphytes

Actions to be taken	<ul style="list-style-type: none"> To study the epiphytic plants associated with mangroves.
Implementing agency	BSI/ Universities, JNRM (Department of Botany)
Time frame and proposed time of start	2 years 2005
Rationale	Mangroves in the islands are extremely rich in epiphytes. These plant communities have never been characterized.
Key methods	Survey, herbarium work.
Fund requirement and source	10 lakhs MOEF
Integration with other programmes/ plans	
Conflict resolution	NIL

11. 7. 6. Conservation of orchids

Actions to be taken	• Collection of orchids; in situ and ex situ conservation; revision of taxa
Implementing agency	BSI / NGO's
Time frame and proposed time of start	3 years establishment 2005
Rationale	Orchids on felled trees are not salvaged. Collection of these at a centre for ex-situ propagation and conservation is feasible.
Key methods	Teams for collection at each felling point; nursery work; tissue culture.
Fund requirement and source	50 lakhs establishment
Integration with other programmes/ plans	Orchid collection to be integrated into working plans of forest divisions.
Conflict resolution	NIL

11. 7. 7. Phytochemistry of local medicinal plants

Actions to be taken	• Establish a laboratory to study the phytochemistry of plants, and to develop a programme for the same.
Implementing agency	BSI with NGO's/ JNRM (Department of Chemistry and Department of Botany).
Time frame and proposed time of start	2 years establishment; ongoing 2005.
Rationale	New possibilities for medicinal use and nutritional use are emerging constantly. A mechanism to isolate the active ingredients and study on medicinal plants is required locally.
Key methods	Construction; survey, chemical analysis
Fund requirement and source	75 lakhs Medicinal Plants Board
Integration with other programmes/ plans	Coordination with existing programmes researching medicinal plants.
Conflict resolution	NIL

11. 8. Multi-Sectoral

11. 8. 1. Establishment of a GIS Cell.

Actions to be taken	<ul style="list-style-type: none"> • Purchase of necessary hardware and software: workstation, A0 scanner, A0 printer, etc. • Purchase of Imageries on 6-month basis • Training of personnel to operate GIS Cell • Execution of specific tasks
Implementing agency	<p>ANET – on BOT basis, and training Forest. Dept., NRSA DRDA, Agri. Dept., Fisheries dept. - users.</p>
Time frame and proposed time of start	<p>IMMEDIATE, URGENT 2 years establishment Ongoing A & N Dept. E & F.</p>
Rationale	<p>The GIS Cell will enable: Impact assessment of tourist sites Mapping of forest areas. Forest changes due to past logging Bamboo and cane cultivation Extent of beach loss Agro forestry alternatives to agriculture Identification of encroachments Mapping of mangroves Identification of wetlands Identification of stepping-stones and wildlife corridors Mapping of coral reef areas</p>
Key methods	<p>Training, field work, mapping, ground truth</p>
Fund requirement and source	<p>60 lakhs establishment 20 lakhs annual running budget</p>
Integration with other programmes/ plans	<p>While beginning has been made with the Forest dept. is, it is anticipated that every Dept. in the A & N Administration will be using this facility intensively.</p>
Conflict resolution	<p>This facility needs dedicated staff of at least a Unit Head at DCF level, and 3-4 support staff. Its mandate normally would be to map the vegetation annually and monitor changes. Other projects should be paid for by user Dept. to avoid resource constraint. To avoid conflict in the priorities of different departments, in case of clashing priorities a resolution mechanism is required.</p>

11. 8. 2. Establishment of pollution monitoring and Environmental Assessment mechanism

Actions to be taken	<ul style="list-style-type: none"> • Establishment water quality laboratory. • Setting up of an EIA Ccll with trained staff and equipment.
Implementing agency	Industries Dept., Pollution Control Committee, Dept. of Environment & Forests Tourism Dept. CARI (Fisheries Science Division)
Time frame and proposed time of start	IMMEDIATE Ongoing.
Rationale	Development activities that harm environments require assessment, using water quality and ETA.
Key methods	Collection of samples, analysis, report preparation Studies using EIA methodology.
Fund requirement and source	60 lakhs
Integration with other programmes/ plans	NGO participation essential for credibility. Prerequisite to any tourism development. Prerequisite to any major construction by APWD, ALHW or Defense.
Conflict resolution	There will be terrific pressure constantly from polluters to suppress results. Hence NGO participation necessary.

11. 8. 3. Strengthening the enforcement mechanism

Actions to be taken	<ul style="list-style-type: none"> • Recruitment of more protection staff by Forest dept. • Purchase of high speed boats • Purchase of, and training in use of GPS, at Forester level.
Implementing agency	Dept. of Environment & Forests.
Time frame and proposed time of start	IMMEDIATE, ONGOING
Rationale	GPS presents new possibilities for detailed, site-specific data collection. Environmental threats need to be documented accurately, using all available resource personnel.
Key methods	Recruitment, training, purchase
Fund requirement and source	Boats: 4 crores GPS : 50 lakhs initially
Integration with other programmes/ plans	Training coordinated with Coast Guard, Police
Conflict resolution	NIL

11. 8. 4. Renewable alternatives

Actions to be taken	<ul style="list-style-type: none"> Departments to review and implement renewable alternatives such as wind energy, novel construction materials, rainwater harvesting, biopesticides, cash crops that do not use pesticides, and the sustainable of eco-tourism.
Implementing agency	Electricity Dept., APWD, Agriculture Dept., IP&T, Forest Dept., DRDA.
Time frame and proposed time of start	Immediate Ongoing
Rationale	Actions will reduce energy usage and reduce long-term impacts on biodiversity. Such actions would also reduce energy impacts, reduce timber use and preserve beaches.
Key methods	Introduction of these concepts as the first priority in the planning stages of all programmes.
Fund requirement and source	Departmental budgets.
Integration with other programmes/ plans	Representatives from each dept. can meet twice a year to discuss new initiatives, along with NGO's.
Conflict resolution	Pressure from contractors and business interests

11. 9. Environment and forests

11. 9. 1. Direction, administration and management

Actions to be taken	<ul style="list-style-type: none"> Establishment of an effective communication network (VHF & HF) Establishment of Local Area Network Establishment of GIS Cell (sec. 11.8.1, above) Establishment of MIS Procurement of arms, boats, vehicles for effective communication and protection
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years. 2005 onwards
Rationale	Needed for effective protection of forests and transparent & efficient administration.
Key methods	Training, Procurement
Fund requirement and source	Rs. 1016 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	Integrated with the Centrally Sponsored Scheme on forest protection
Conflict resolution	NIL

11. 9. 2. Silvicultural Research

Actions to be taken	<ul style="list-style-type: none"> • Ongoing projects: • Assessment of regeneration status of logged areas • Introduction trials of solid/ thick walled bamboos • Genetic improvement of Padauk • Genetic improvement of Casuarina • Studies on seed biology and phenology of important species • Proposed in the next five years: • Biofertilizer trials in important species • Macro propagation of important tree species • Comparative study of selection system vs. irregular shelterwood system • Development of agro forestry models • Regeneration and development of medicinal and aromatic plants
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years. 2005 onwards
Rationale	Needed for better understanding of the forest ecosystem and improving its productivity
Key methods	Training, Procurement, Field trials
Fund requirement and source	Rs. 203 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	This will be integrated with the collaborative projects with the ICFRE and other national level institutes.
Conflict resolution	Overlap with the ongoing/proposed programmes of other research organizations likely. Resolutions by collaboration and by following the National Forestry Research Plan in which the areas of research and the agencies have been identified.

11. 9. 3. Forestry Training and Education

Actions to be taken	<ul style="list-style-type: none"> • Training of forest executive staff in anti-poaching and implementation of legislations.
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years. 2005 onwards
Rationale	Needed for effective protection of forests and conservation of biodiversity.
Key methods	Training
Fund requirement and source	Rs. 85 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	
Conflict resolution	NIL

11. 9. 4. Natural Regeneration and Enrichment of forests

Actions to be taken	• Aided natural regeneration of areas already harvested
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years, 2005 onwards
Rationale	Needed for regeneration of forests and their enrichment with species required for local use.
Key methods	Planting operations
Fund requirement and source	Rs. 845 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	Agri. Dept & Silviculture Dept.
Conflict resolution	NIL

11. 9. 5. Forest Settlement and Consolidation

Actions to be taken	<ul style="list-style-type: none"> • Survey and demarcation of forest boundaries • Completion of forest settlement process • Creation of a Land Cell • Establishment of a Forest Land Records System • Reconciliation of revenue records with forest notifications • HRD for forest boundary management
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years, 2005 onwards
Rationale	Needed for effective protection of forests and efficient forest management.
Key methods	Training, Procurement
Fund requirement and source	Rs. 145 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	
Conflict resolution	NIL

11. 9. 6. Forest Resources Survey and Working Plan

Actions to be taken	<ul style="list-style-type: none"> • Revision of the Working Plans of all the forest divisions as per the directions of the Supreme Court
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years, 2005 onwards
Rationale	The forests are required to be worked multiple use- to meet the timber and NTFP requirements of the local population and the environmental requirements. Working Plan is a prerequisite for working in any forest area.
Key methods	Survey and enumeration
Fund requirement and source	Rs. 205 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	
Conflict resolution	NIL

11. 9. 7. Harvesting and Development of Non-timber Forest Produce

Actions to be taken	<ul style="list-style-type: none"> • Estimation of availability of canes and bamboos in the forests • Raising of cane and bamboo plantations • Raising of medicinal plants • Vanilla cultivation
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years, 2005 onwards
Rationale	Non-timber forest produce are required to meet routine local requirement. The solid bamboos are required for structural needs of the rural population, and to reduce the pressure on the forests for ballies and posts.
Key methods	Survey and enumeration, plantation
Fund requirement and source	Rs. 440 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	Agri. Dept.
Conflict resolution	NIL

11. 9. 8. Social Forestry, Agro forestry and Extension Forestry

Actions to be taken	<ul style="list-style-type: none"> • Raising of plantations on non-forest land, viz., roadside, barren land, community land, agricultural land • Seedling distribution to public • Extension and publicity to create environmental awareness. • Funding activities of the National Green Corps in 100 schools
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years, 2005 onwards
Rationale	Need for awareness environmental and forest protection. Plantations on non-forest land to reduce pressure on forest.
Key methods	Raising of plantations, conducting awareness creation programmes for school children and public. Publicity programmes through AIR, Doordarshan, local media, etc.
Fund requirement and source	Rs. 506 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	Agri. Dept.
Conflict resolution	NIL

11. 9. 9. Forest Utilization

Actions to be taken	<ul style="list-style-type: none"> • Harvesting of 15000 cum of timber to meet the local needs.
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years, 2005 onwards
Rationale	Wooden structures in ANI require maintenance. Timber is renewable resource use, high-input cement concrete structure requiring damaging mining activities.
Key methods	Reduced impact logging
Fund requirement and source	Rs. 1840 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	
Conflict resolution	NIL

11. 9. 10. Biodiversity, Wildlife Conservation and Eco-development

Actions to be taken	• Identification and establishment of new protected areas.
	• Consolidation of existing PAs
	• Strengthening of infrastructure with wildlife wing by procurement of arms, vehicles, vessels, communication equipment and construction of buildings.
	• Establishment of Biological Park.

Implementing agency Dept. of Environment and Forests

Time frame and
proposed time of start 5 years, 2005 onwards

Rationale The wildlife wing is understaffed with limited infrastructure for effective conservation of biodiversity, especially for PAs.

Key methods Procurement, Construction, Training

Fund requirement
and source Rs. 1680 lakhs, Plan scheme (X 5-year plan)

Integration with other
programmes/ plans

Conflict resolution NIL

11. 9. 11. Improvement of Government Saw Mills

Actions to be taken	• Procurement of machinery
	• Renovation of old structures and machinery
	• Augmenting facilities for timber treatment

Implementing agency Dept. of Environment and Forests

Time frame and
proposed time of start 5 years, 2005 onwards

Rationale The Govt. saw mills are outdated and require replacement. Timber treatment will reduce timber demand.

Key methods Procurement

Fund requirement
and source Rs. 612 lakhs, Plan scheme (X 5-year plan)

Integration with other
programmes/ plans

Conflict resolution NIL

11. 9. 12. Protection of forests and coastal ecosystem

Actions to be taken	<ul style="list-style-type: none"> • Procurement of trucks, jeeps, arms and fast boats. • Improvement of communication system
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years. 2005 onwards
Rationale	Additional department resources needed for effective protection, in light of increasing pressures on forest and coastal ecosystems.
Key methods	Procurement
Fund requirement and source	Rs. 550 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	Coast Guard, Navy and Police
Conflict resolution	NIL

11. 9. 13. Conservation of mangroves

Actions to be taken	<ul style="list-style-type: none"> • Survey of mangrove areas to identify degraded locations • Planting of mangroves in the degraded patches
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years. 2005 onwards
Rationale	Conservation of mangroves essential for coastline and marine life protection.
Key methods	Survey, Plantation
Fund requirement and source	Rs. 125 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	
Conflict resolution	NIL

11. 9. 14. Research on coral reefs

Actions to be taken	• Survey, delineation of coral reefs; measurement of land based impacts
Implementing agency	JNRM/NGO's/WII/CARI
Time frame and proposed time of start	Immediate 5 years
Rationale	Baseline information on distribution and abundance of corals, including new species, is lacking. Detrimental effects on corals require documentation and remediation.
Key methods	Survey, monitoring, analysis of water samples.
Fund requirement and source	5 crores /UNDP
Integration with other programmes/ plans	Inputs from this project will be used by the Agriculture Dept. for better land use planning; by IPT to promote new areas for tourism in a sustainable fashion.
Conflict resolution	NIL

11. 9. 15. Eco-tourism

Actions to be taken	• Procurement of camping equipment, boats, glass bottom boats for development of ecotourism
Implementing agency	Dept. of Environment and Forests
Time frame and proposed time of start	5 years. 2005 onwards
Rationale	The islands offer tremendous scope for low-volume high value ecotourism which will help in generation of employment and revenue as well as help in the appreciation of nature and education.
Key methods	Procurement
Fund requirement and source	Rs. 335.50 lakhs, Plan scheme (X 5-year plan)
Integration with other programmes/ plans	Tourism dept.
Conflict resolution	NIL

12. 1. Appendix 1: "Order of Supreme Court dated 7 May, 2002 & Recommendations of Shekhar Singh Commission"

ORDER

After hearing the learned Amicus Curiae, counsel for the parties and taking into consideration the affidavit of the Union of India - Ministry of Environment and Forests in relation to survey of ecosystem of Andaman and Nicobar Islands, the learned Amicus Curiae has made certain suggestions.

There does not seem to be any objection to this Court in accepting the Report of Shri. Shekhar Singh that some modifications have been suggested. We therefore, in the first instance, accept the Report of Shri. Shekhar Singh.

On a query being raised by us, Mr. Altaf Ahmed, learned Additional Solicitor General, appearing for The Union Territory of Andaman & Nicobar Islands on instructions informed the Court that there is no social forestry in Andaman & Nicobar Islands. The wood which is being cut is from the natural forest and plantation of teak, etc. has taken place in the forest, which had been worked and approximating 40,000 cubic metres of wood is cut from the forest annually for the purposes of the small mills the total logging of wood being approximately 1,30,000 cubic metres per year. In the last two years, this figure has come down but the fact remains that instead of resorting to social forestry and thereby providing employment to the people in growing forest at the present moment the natural forests are being cut and the timber sawn.

Andaman & Nicobar Islands is one of the hot spots and is in the eco-fragile area and has, therefore, the eco-diversity thereby has to be preserved. For this, it is essential that the natural forest is protected and re-generation allowed to take place.

We are also informed that the existing saw-mills have a subsisting license valid till 30th March, 2003. The saw-mills and the other wood-based industries in the Andaman & Nicobar Islands are not permitted to cut the trees and supplies to them are made only by the Government itself or through its Corporation. Some of these saw-mills and industries have logs of wood and sawn timber in their stock. It would therefore be iniquitous to deprive them of an opportunity to utilize the stock for which payment has been made to the Government for the purchase of wood. However, it is to be borne in mind that fresh logging of wood must cease immediately.

After taking all facts and circumstances into consideration, we issue the following directions:

1. All felling of trees from the forest of little Andaman Islands, the national park and sanctuaries, the tribal reserves and all other areas shall stand suspended.
2. For the areas in which there are working plans, the Government through the Chief Secretary shall disclose on an affidavit -
 - I. The extent of felling and re-generation permitted under these working plans during the last 10 years.
 - II. The compliance with re-generation/re-plantation/re-forestation targets under the working plans and reasons if any for the shortfall.
3. The working plan of the Andaman & Nicobar Islands should be re-worked on the basis as was applied to the State of M.P. and others, namely that before any felling of trees, there should first be compulsory afforestation/re-generation, the felling permissions would be based upon the extent of re-generation of forest undertaken and not the other way round.

4. No felling of tree (under the working plan or otherwise) shall be permitted for meeting any raw material requirements of the plywood, veneer, black board, match stick or any other wood-based industry.
5. In drawing up the new working plans the Government shall formulate a Committee with one Ecologist who is proficient with the ecology of Andaman.
6. The working plans so formulated shall be placed before this Court within a period of twelve weeks.
7. The trees felled under the working plan in the manner indicated aforesaid should be utilized for the requirements of the local inhabitants.
8. The licenses of all the saw-mills and wood-based industries shall not be renewed after 31st March, 2003. This will not debar the authorities from canceling licenses in accordance with law, if there is no breach of the License Committee by the Licensees before that date.
9. The ecology of the area does not permit any kind of industrial activity for which the wood is likely to be consumed. Therefore, licenses of wood-based industries shall stand cancelled but they will be permitted to exhaust the existing stock till 31st March, 2003.
10. The Union of India if it so adopts and thinks appropriate may take steps for re-locating the dislocated wood-based industries in the main land area anywhere in India as long as it is not within the vicinity of forest area. Henceforth for meeting the local requirements it is only the Government saw-mills which shall operate. No fresh wood or logs shall be given to any of the saw-mills or the wood-based industries till fresh working plans are prepared and submitted to this Court and the approval obtained.
11. With immediate effect, there will be no movement of logs or timber in any form including sawn timber from Andaman & Nicobar Islands to any part of India or anywhere else.
12. Regularization of encroachments on forest land in any form, including allotment/use of forest land for agricultural or horticultural purposes, shall be strictly prohibited.
13. All those families who have been identified as having encroached on forest land prior to 1978 and have not yet shifted to their allotted rehabilitation sites, shall be given one month's notice to vacate their encroachments and shift to the allotted land. Failing this, their allotment shall be cancelled and they shall be forcibly evicted within three months of the deadline being over, without any further claim to land or any other form of rehabilitation. Such notices should be issued within six weeks.
14. Similarly, those among the pre-1978 families that have shifted to their allotted sites but have occupied more land than they were entitled to shall also be given one month's notice to vacate the extra land occupied by them. On the expiry of this notice period, the allotments of those who have not complied with this notice shall be cancelled and they should be forcibly evicted within three months, without any further claim to compensation or land. Such notices should be issued within six weeks.
15. All post 1978 forest encroachments shall be completely removed within three months.
16. For the eviction of encroachers, an effective action plan shall be prepared and implemented under direct supervision, monitoring and control of a Committee under the Chairmanship of the Lt. Governor with Chief Secretary, Principal Chief Conservator of Forests and reputed NGO representatives, its members. The Chief Secretary, Andaman & Nicobar Islands, shall file every month an affidavit about progress of eviction of encroachments.
17. The process of issue of identity cards to all the residents shall be completed within a period of six months.
18. The extraction of sand shall be phased out @ minimum 20% per year on reducing balance basis to bring the sand mining to the level of 33% of the present level of mining within a maximum period of 5 years.
19. The approvals accorded by Ministry of Environment & Forests under the Forest (Conservation) Act, 1980, shall be reviewed by a Committee consisting of Secretary, Envi-

ronment & Forests, Director General of Forests and at least one non-official member of the Forest Advisory Committee constituted under the Forest (Conservation) Rules to restrict the approvals to the barest minimum needed to serve emergent public purposes. Felling of trees shall commence only after the process of compensatory afforestation has actually been undertaken on the ground. In future, the proposals shall be considered for approval only after detailed Environmental Impact Assessment has been carried out through an independent agency identified by Ministry of Environment & Forests.

20. Specific actions shall be undertaken by Ministry of Environment & Forests/Andaman & Nicobar Islands Administration on the other recommendations of Shri. Shekhar Singh Report which are not specifically dealt with in above orders. Ministry of Environment & forests and the Andaman & Nicobar Islands Administration shall file an affidavit within three months giving details of action taken by them on each of such recommendations.

Copy of this order to be sent by the Registry to the Chief Secretary, Andaman & Nicobar Islands for information and compliance.

RECOMMENDATIONS

1. Felling of trees and collection of non-timber forest produce (NTFP) should be banned from the forests of Little Andaman Island and all tribal reserves except for (i) collection of NTFP from already worked forests of Little Andaman and from forest areas designated for the purpose in the Nicobar group of Islands, for meeting the legitimate consumption of local inhabitants; and (ii) collection of timber and other forest produce by tribals living within tribal reserves for meeting their bonafide needs.
2. Harvesting of all forest produce including timber and NTFP should be completely prohibited from National Parks and sanctuaries.
3. In addition to areas covered under 1 & 2 above, no felling of trees should be allowed in any unworked forest area, i.e., area where felling of trees as per working plans, working schemes, felling schemes or approved working plans, has not taken place earlier. There should also be no diversion of forestland from any such unworked area or from areas covered under 1 and 2 above, without the specific orders of the Supreme Court.
4. No felling of trees for whatsoever reasons or justification should be carried out to supply to, or to meet the raw material requirement of plywood, veneer, blackboard, match stick or any other such wood based units except to local small-scale units (including saw mills) solely for meeting the local requirement for sawn timber and other wood based products.
5. For meeting the timber and other forest produce requirements of inhabitants of the ANI, felling of trees from forest areas not covered under 1, 2 & 3 above, i.e., forest area worked earlier in accordance with working plans, working schemes, felling schemes or approved working plan and excluding areas falling within national parks, sanctuaries, tribal reserves, or Little Andaman, may be allowed. Such felling may be undertaken as per prescriptions of the working plans approved by the MoEF. These plans should also contain action plans for removing, in a phased manner, trees of commercial species that are in number or concentration in excess of what is found in a natural forest of the same type and similar location. Concurrently, efforts should be made to bring back the forest to its natural profile by encouraging/ reintroducing those species of fauna and flora that naturally occurred in these forests prior to their being "converted". The working plan

should also contain sufficient provisions for regeneration of felled areas. In accordance with an earlier Supreme Court order of 22nd September 2000, felling of trees should be allowed only if sufficient financial provisions for implementing the working plan prescriptions have been made.

6. In the meanwhile, the present ban on felling of trees may be continued and the local requirement of timber and other forest produce may be met by utilizing the already felled trees and sawn timber lying with the forest department and the ANIFPDC.
7. Once the stock of already felled trees and sawn timber is depleted, the local requirement of timber should be met, as far as possible, by harvesting the monoculture and mixed plantations of padauk, gurjan, teak and other species. The felling of trees from already worked natural forest, as specified in 5 above, should be undertaken only to meet the balance requirement. However, if the local requirement of timber and other forest produce is more than what could be obtained by felling of plantations and sustainably extracting trees from worked areas, as specified in 5 above, the same may be met by bringing timber in from other parts of the country. Under no circumstances should the over harvesting of the forest available for felling under Para 5 above be permitted or undertaken.
8. There should be no expansion of monoculture or commercial plantations on forestland. The existing plantations of oil palm, rubber and teak are reportedly no longer viable and should be phased out. The land so released should, in so far as it is forestland, be regenerated as specified earlier. Consequently, the Andaman and Nicobar Islands Forest Plantation and Development Corporation Ltd. (ANIFPDC) should be wound up as it was primarily set up to promote commercial forestry and plantations, especially in Little Andaman.
9. At the same time, efforts should be made to reduce the level of demand for timber and for firewood. For the purpose, the A & N Administration should investigate and implement methods of achieving this, including the conversion to the wood and bamboo based "Assam type" constructions, which is both less timber intensive, and safer in earthquakes, than the present all-timber or RCC buildings.
10. There should be a complete ban on the establishment of any new wood based unit for the next 10 years.
11. All existing small-scale wood based units (saw mills) should be relocated within industrial estates or, where industrial estates are not feasible, in locations contiguous to forest offices or otherwise convenient for the forest department to monitor. This relocation should be completed within one year, after which the non-complying saw mills should be closed down. These saw mills should also be required to obtain a license from the ANI Forest Department within three months and to maintain such records as may be prescribed by the forest department. Their license may be renewed every year at the discretion of the ANI Forest Department, after the department has satisfied itself that a) the unit was not involved in the use of any illegal timber; b) the prescribed records were properly maintained; c) all provisions of the act, rules and the terms and conditions stipulated by the forest department from time to time have been complied with. Necessary rules, guidelines etc., for the purpose, should be prescribed by the forest department within three months.
12. No subsidy of any type, including transport subsidy, should be given to any wood based unit.
13. Existing medium and large scale wood based industries (including plywood, veneer, and match industries) can be allowed to function provided they import their entire requirement of wood and other forest based raw materials from the mainland or from abroad. No subsidies should be allowed to them.
14. No timber, either as logs or as sawn timber or plywood/veneer, or in any other form, should be transported out of the Islands through any means whatsoever. This should

not, however, inhibit the transportation, as personal baggage, of a reasonable quantity of wooden handicrafts by tourists or of personal articles by those permanently leaving the islands. Also, where a wood based industry, as specified in 13 above, imports its entire wood and forest based raw material requirement, then it should be permitted to export its finished product.

15. All timber, bamboo and cane used for construction and requiring treatment in order to extend its durability and life, should be so treated and the administration should ensure that requisite capacity to treat all such timber is in position within a period of six months. After the expiry of this period, no timber, bamboo or cane of the type requiring treatment should be sold for use in building and construction activities, or used for such purpose, unless it has been appropriately treated.
16. Any further regularization of encroachments on forestland in any form, including allotment/ use of forestland for agricultural or horticultural purposes, should be strictly prohibited.
17. All those families who have been identified as having encroached on forest land prior to 1978 and have not yet shifted to their allotted rehabilitation sites, should be given three months notice to vacate their encroachments and shift to the allotted land. Failing this, their allotment should be cancelled and they should be forcibly evicted within three months of the deadline being over, without any further claim to land or any other form of rehabilitation.
18. Similarly, those among the pre-1978 families that have shifted to their allotted sites but have occupied more land than they were entitled to, should also be given three months notice to vacate the extra land occupied by them. On the expiry of this notice period, the allotments of those who have not complied with this notice should be cancelled and they should be forcibly evicted within three months, without any further claim to compensation or land.
19. All post 1978 forest encroachments should be completely removed forthwith and, in any case, within six months. Post 1978 encroachers (except for foreign nationals) should be allotted homesteads in revenue land and training and opportunity for self-employment or for other types of livelihood activities provided.
20. The forest officials in the ANI should be given requisite powers to do this, including:
 - a. Power of summary eviction of encroachments: As in the case of Madhya Pradesh, vide Section 80A, IFA, 1927.
 - b. Magisterial powers to Assistant Conservator of forests: The Assistant Conservator of Forests should be appointed as executive magistrates/ special executive magistrates in order to oversee the evictions carried out by the Range Officers on receipt of orders of eviction from the estate officers.
21. For the purpose, an effective action plan should be prepared and implemented under direct supervision, monitoring and control of a committee comprising of the Lt. Governor, Chief Secretary, Principal Chief Conservator of Forests of ANI, and reputed local NGO representatives. The Chief Secretary, ANI, may be asked to file a monthly progress report in the Supreme Court.
22. In order to prevent any further encroachments and rampant immigration, the Administration should, within three months, regulate the entry of people to the islands by having the Islands declared as an inner line area and by imposing relevant restrictions under section 3 and other provisions of the Environment (Protection) Act of 1986. In accordance with this, non-residents entering the islands should have to invariably register themselves so that those who do not return to the mainland within a reasonable time can be traced and, where they have illegally encroached on land, can be evicted from these encroachments at the earliest. In addition, entry to the more vulnerable and forested areas of the Islands should be restricted.

23. Once this regulation is in position, the administration should in a time bound manner issue identify cards to all the residents so that there is no gap in the period of identification and issuance of ID cards. This would ensure that fresh illegal encroachers are easily identified. Subsidised travel to the Islands should, once identity cards have been issued, be available only to bonafide residents of the Islands.
24. Divisional Forest Officers and, where relevant, village protection committees, as described later, should be made responsible for prevention, early detection and quick eviction of new forest encroachers.
25. The forest department should be strengthened and appropriate village institutions set up for the purpose, as detailed later
26. The Andaman Trunk Road should be closed to all vehicular traffic from Miletalak in South Andaman to the northern boundary of the South Andaman Island. Similarly, it should be closed to all traffic from Kadamtala (corresponding to Prolobjig camp No.3) in Middle Andaman upto Kaushalya Nagar (corresponding to Prolobjig camp No.15). This should be done within three months. Further, no person except for the Jarawas living in the Reserve should be allowed to enter the Reserve by any means unless he/she is permitted by the Principal Chief Conservator of Forests, and the Secretary, Tribal Welfare, ANI Administration, and no such permission should be granted unless the person is proceeding on bonafide work related to the welfare of the tribals or the protection of the area.
27. The felling of 27 trees for the 33 KV transmission line from Bamboo Flat to Minnie Bay, and 17 trees for construction of rural road from Adajig to Flat Bay Village should be permitted as a one-time relaxation, as these projects are already in their final stages, a small number of trees are involved and, reportedly, necessary clearances had been obtained from the MoEF prior to the Supreme Court's order of 10.01.01. However, all other proposals or clearances under the Forest (Conservation) Act of 1980 or the Environment (Protection) Act of 1986, where diversion of land or felling of trees or other activities that would have an impact on the environment, are still to be undertaken, should be put up for review by the Supreme Court.
28. For the conservation and protection of the forests and other ecosystems, an effective action plan should be prepared by the ANI Forest Department, in consultation with local NGOs and experts. This plan should also envisage a suitable enhancement of the protected area network (PAN), especially in the main island of the Andaman and in the Nicobar Group. All unworked forest areas in Diglipur, Mayabunder, Middle Andamans and Baratang should be made into national parks, leaving a buffer belt between the national park boundary and the edge of revenue settlements, for protection by village protection committees. In addition, there should be a consolidation of the nearly hundred small island parks and sanctuaries and they should be constituted into viable units encompassing the marine areas surrounding them. This plan, after being approved by the MoEF, should be strictly implemented. The necessary funds, vehicles, equipments, human power, police help and legal power required for the effective implementation of this action plan should be made available by the ANI administration.
29. Appropriate regulations under existing Acts like the Environment (Protection) Act of 1986, with similar objectives as The Delhi Preservation of Trees Act, 1994, currently in force in the Union Territory of Delhi, should be set in place in ANI, within six months, to regulate the felling of trees on non-forest land.
30. The Forest Department should be immediately strengthened in order to be able to effectively prevent poaching.
31. Forest Officers should be given adequate powers, under the Indian Forest Act of 1927 (IFA) as has been done in other states, to meet the threat of poaching. These could include:

- a. Power of confiscation: as provided for vide Section 52, 52A, 52B and 52C IFA, 1927 in Bihar, Section 52A and 52B in Himachal Pradesh, Section 52, 52A, 52B, and 52C in Madhya Pradesh, Section 62A to 61G of Goa, Section 61A to Section 62G of Gujarat, and Section 61A to 61G of Maharashtra.
 - b. Increase in the limit fixed for amount of compensation for trees under section 68(3) IFA, 1927: The present limit of Rs. 50 is required to be increased to Rs. 10000/- as in Goa.
32. A co-ordination mechanism should be set up where the forest department, the civil administration, the Coast Guard and the Combined Defence Command in ANI can take coordinated action against poachers, especially against foreign poachers.
 33. No exotic species of fauna or flora should be introduced into the islands. Accordingly, a suitable set of guidelines and procedures should be developed for the purpose.
 34. A time bound action plan should be drawn up to deal with the exotics already on the island, including weeds, and their removal/ eradication should be taken up on a war footing, including the translocation of elephants back to the mainland and the inhibition of breeding, by deer, by darting the alpha males with anti-fertility drugs, as has been successfully tried in other countries.
 35. The practice of distributing timber and NTFP free to settlers should be discontinued. Instead, rural populations should be formed into village forest protection committees and, as per the joint forest protection norms prevalent in other parts of the country, the amount of timber and NTFP required by village communities should be given to them on the basis of a memorandum of understanding, in return for their role in protecting the forests adjacent to their settlements and in detecting and preventing encroachments.
 36. Government departments, including defences and PWD, should be supplied fuel wood and other required forest produce by the forest department and should not be permitted to directly collect these from the forests.
 37. Concurrent efforts should be made to minimize demand for forest-based resources. The Administration should encourage the use of sawdust as fuel, as is the practice in many other parts of the country. They should also investigate the possibility of replacing firewood as a domestic fuel by gas and consider giving a one-time subsidy for the purchase of gas stoves and cylinders to the poor rural population. Adequate supply of LPG to the Islands should be ensured on a priority basis.
 38. The extraction of sand should be phased out and no further extension should be granted after the current extension is over on 30 September 2002.
 39. As already mentioned earlier, alternate material for construction, including treated bamboo and soft woods, should be encouraged as this is less damaging to the environment and safer in case of an earth quake. Stone dust should be utilized where use of concrete is essential.
 40. No concrete or permanent infrastructure for tourism should be built on any forest area in the Islands. Tourist activities in forest areas should be restricted to tented accommodation or temporary wooden/ prefabricated structures that can be dismantled easily and moved to another side. These areas should remain under the control of the forest department who should be responsible for ensuring that the quantum and type of tourism is such that it does not in any way degrade the forests or other ecosystems.
 41. A proper eco-friendly tourism plan should be developed for the Islands within one year. This plan should also do an economic and a distributional analysis to highlight how tourism can make a net contribution to the economy of the Islands and how the economic benefits can be equitably distributed among the various segments of the local society and generate local employment.

42. Such a plan must be in conformity with the requirement for conserving the ecological and cultural integrity of the Islands and not pose a security threat to this strategically important area.
43. The forest department and the administration of ANI should make public at the beginning of each year the proposed uses of natural resources, including forests. This detailed information specifying, among other things, uses, locations, quantum, purpose and users, and giving details of the basis on which these decisions have been made, should be published in the local newspapers and also made available on web site to be maintained for the purpose by the administration. At the end of each year, actual use, deviations from the proposals and the reasons thereof, must also be similarly made public.
44. The various forest working plans/ protected area management plans should also be made accessible to the public, as soon as they are approved. Copies should be kept at all public libraries and other accessible places in the Islands. In addition, copies should be freely made available to the general public, on demand, after charging actual costs of photocopying.
45. All officers of the administration, including forest officers, should undergo an orientation training of at least five days, every three years, to acquaint themselves with the ecological characteristics of the Islands and the options available for their economic development in an environmentally and socially sustainable manner. Officers being posted from the mainland to these islands should be so oriented within three months of their posting.
46. The Government of India and the ANI Administration should consider setting up an Island Development Institute in ANI, that can become a center of research, training and education for managing island and coastal ecosystems in a sustainable manner. This institute could not only cater to national needs but, over time, also become a regional institution. A proposal to the effect already exists and was submitted to the IDA many years back. It can be suitably modified and considered.
47. There are many areas that need to be properly researched and many problems that need innovative solutions. These include:
 - a. An assessment of the ecological differences between worked and unworked forests.
 - b. Methods of returning the worked and encroached forests to their natural state.
 - c. Methods of further working forests in a manner that minimizes impact on biodiversity and the environment.
 - d. Methods to conserve soil and water.
 - e. Feasibility of generating energy through non-conventional methods, including wind and tidal energy.
 - f. Methods of treating garbage and other pollutants, thereby protecting the coastal and marine environment from degradation.
 - g. Methods of using alternate building materials that are environmentally friendly and sustainable.

12. 2. Appendix 2: ANI Site-Specific threats

Area	Threats	Consequences	Actions necessary
Nicobars (General)	Hunting	Megapode, Pigeons & fruit Bat population affected	Ban sale & use of air guns in ANI.
	FD infrastruc- ture inadequate	Mobility and ability to enforce Wildlife laws impaired	Purchase of fast boats; posting of ad- ditional patrol staff
	Poaching by foreign boats	Loss of marine resources	As above
	Sand mining	Loss of marine turtle habi- tat & coastal forest	Enforcement & reduce use
Great Nicobar Island	Immigration pressures from non-tribals	Deforestation, social conflicts between tribals and non-tribals.	Ban and enforcement of Protection of Abo- riginal Tribes Regula- tion Act, 1956.
	Crop raiding by macaques	Human Wildlife conflict leading to killing of macaques, loss of crop	Research methods to reduce crop raiding
	Unchecked popula- tion growth	Resource crunch and water scar- city, reduction of Biosphere area	Planned growth
	Rebuilding of East West road year after year.	Increased tourism & more access to Shompens, erosion and sedimentation of streams, wasteful expenditure.	Abandonment of this plan
Katchal	Proposed road	Will destroy last remnant for- est as well as reduce popula- tion of northern subspecies of Nicobar Megapode	Insufficient details available; Abandon- ment of this plan.
Tillanchong	Overseas Poachers	Poaching of marine resources by foreign poachers	Monitoring and policing
Car Nicobar	Dumping of garbage by passing ships observed	Marine pollution observed leading to damage of reefs	Marine Act to be enforced strictly
Little Andaman	Tourism activity in Onge Reserve	Threat to tribal life style; sea turtle beaches affected.	ANPATR, 1956 to be strictly implemented.
	Hunting of the Andaman Wild Pig by settlers	Decline in population and non availability of wild pig for the Onge people	Monitoring of the Reserve, posting of additional staff
	Poaching of tim- ber resources	Destruction of pristine forest	Monitoring of the Reserve, posting of additional staff
"Great" Anda- man group	Browsing by chital	Regeneration of forests seriously affected; species diversity reduced	Eradication/ Culling
	Hunting of the Anda- man Wild Pig	Major decline in population and depletion Jarawa food source	Monitoring of the Reserve, posting of additional staff to monitor wet coast
	Reduced Agricul- tural productivity	Lower income to residents	Agro forestry initia- tives to be launched
	Over harvesting outside and in protected areas to cater to the export markets for reef fishes crab and lobster	Reduction catch, evident reduction in availability and sizes caught	Closed season to be enforced, management and harvesting regimes to be applied urgently.
	Fishermen preferen- tially hunting shark	Shark populations declining	Enforcement of Fishing Rules: closed season and shark as by catch only
	Inappropriate agricultural practices; declining yields	Pollution due to fertilizers and pesticides; this and siltation lead to damage to coral reefs	Phasing out rice farming by encouraging agro forestry.

	Introduction of exotics	Damage to trees (elephant); reduction of regeneration (chital); competition with endemics for nesting sites (mynahs); destruction of sea turtles and nests (Feral dogs)	Programme to eliminate all exotics; steps to prevent any new exotic being brought into the islands.
Rutland	Sand mining and hunting wild pig Andaman teal and marine turtles Feral dogs menace	Coastal erosion, species loss, loss of marine turtle nesting beaches	Effective enforcement of law
South Andaman	"Jarawa" tourism in spite of Administration ban, hunting within the reserve for pig and deer	Cultural contamination of Jarawa & depletion of their resources, learning of inappropriate dietary habits	Effective enforcement of law
	Opening up of Manjeri for tourism	Increased pressure on MGMNP	Environmental Impact Assessment to be done and implemented
	Encroachment of protected areas continues unabated eg. Loha Barrack	Loss of habitat, Water scarcity	Effective enforcement of law
South Andaman	Port Campbell and other areas along the west coast has become fishermen and poachers camping site	Conflicts, Cultural contamination of Jarawa; learning of inappropriate dietary habits and loss of their resources.	Effective enforcement of law
Baratang	Teak plantations, poaching and Sand mining	Water scarcity, species loss, loss of nesting habitat for marine turtles	Regeneration of evergreen forests, reduction of sand mining and sand use
Middle Andaman	"Jarawa" tourism, poaching	Cultural contamination of Jarawa; learning of inappropriate dietary habits, species loss and depletion of resources for the Jarawa	Effective enforcement of law
Flat Island	Becoming a fisherman camp site	Cultural contamination of Jarawa; learning of inappropriate dietary habits	Effective enforcement of law
MGMNP	Oil spill from boats	Damage to corals and beaches	Marine Act to be enforced strictly
	Tourist damage to corals	Damage to coral reefs	Visitors to be regulated; greater awareness
MGMNP	Lack of local participation	Exploitation of resources, minimal cooperation	Explore possibilities
	Sand mining	Destruction of beaches; reduced areas for turtle nesting.	Ban required; interim Govt. control of collection and sale
	FD infrastructure inadequate,		Explore alternative management strategies
	Propellor use in MGMNP	Damage to coral reefs	Boat traffic routes to be created, mooring buoys to be used.
Ritchie's Archipelago	Unchecked Dive Tourism, poaching, and fishing within the park and over reefs	Loss of revenue, Damage to reef	Create infrastructure & management plan.
North Andaman	Unchecked encroachment of reserve and revenue forests	Resource depletion and unchecked population growth	Effective enforcement is currently taking place

	Uncontrolled resource exploitation from surrounding islets, poaching and illegal timber extraction by settlers	Resource depletion and local extinction	Create infrastructure to monitor region
Interview	Damage by elephants & Deer	Damage to forest regeneration	Removal
Delgarno & Trilby	Illegal timber extraction	Habitat loss	Monitoring
Narcondam	Police and Goats	Threat to the Endemic Hornbill, habitat	Monitoring & eradication of goats
Barren Island	Goats	Major impact to habitat	Monitoring & eradication of goats
South Sentinel	fishermen and poachers camps	Giant robber crab, marine turtles & pied imperial pigeon nesting habitat.	Monitoring and enforcement required

Source: Andrews, 1999; 2000a; b; c; 2001; 2002; Andrews & Sankaran, 2002; Ali, 2001; 2004; Aul, 2002; Chandi, 1998; Gandhi, 2000; Sankaran, 1995; 1998.

12. 3. Appendix 3: Avifauna of ANI

	Species	Common name	Distribution
1	<i>Accipiter butleri</i> *	Nicobar sparrow hawk	N- Nt
2	<i>Accipiter gularis</i>	Japanese sparrow hawk	A
3	<i>Accipiter nisus</i>	Eurasian sparrow hawk	A
4	<i>Accipiter soloensis</i>	Chinese sparrow hawk	N
5	<i>Accipiter virgatus</i>	Bcsra	A & N
6	<i>Aceros narcondami</i> *	Narcondam hornbill	A-Vu 1: D2
7	<i>Acridotheres fuscus</i>	Jungle myna	A
8	<i>Acridotheres tristis</i>	Common myna	A & N
9	<i>Acridotheres tristis</i>	Common myna	A & N
10	<i>Acrocephalus aedon</i>	Thick billed warbler	A
11	<i>Acrocephalus bistrigiceps</i>	Black browed reed warbler	
12	<i>Acrocephalus dumetorum</i>	Blyth's reed warbler	
13	<i>Acrocephalus orientalis</i>	Oriental reed warbler	A
14	<i>Acrocephalus stentoreus</i>	Clamorous reed warbler	A & N
15	<i>Actitis hypoleucos</i>	Common sandpiper	A & N
16	<i>Aethopyga siparaja</i>	Crimson sunbird	
17	<i>Alcedo atthis</i>	Common kingfisher	A & N
18	<i>Alcedo meninting</i>	Blue eared kingfisher	A
19	<i>Amandava amandava</i>	Red avadavat	
20	<i>Amaurornis phoenicurus</i>	Whitebreasted water hen	A & N
21	<i>Anas gibberifrons</i> *	Sunda teal	A
22	<i>Anous minutus</i>	Black noddy	A
23	<i>Anous stolidus</i>	Brown noddy	A & N
24	<i>Anthus cervinus</i>	Red throated pipit	
25	<i>Anthus godlewskii</i>	Blyth's pipit	
26	<i>Anthus richardi</i> *	Paddyfield pipit	A- R
27	<i>Anthus richardi</i>	Richardi's pipit	
28	<i>Aplous panayensis</i>	Asian glossy starling	A & N
29	<i>Apus apus</i>	Common swift	Unknown
30	<i>Ardea cinerea</i>	Grey heron	A & N- R
31	<i>Ardea purpurea</i>	Purple heron	A & N
32	<i>Ardeola grayii</i>	Indian pond heron	A & N- R

33	<i>Arenaria interpres</i>	Ruddy turnstone	A & N
34	<i>Artamus leucorhynchus</i>	White breasted wood swallow	A
35	<i>Aviceda leuphotes</i>	Black baza	A
36	<i>Bubulcus ibis</i>	Cattle egret	A & N- R
37	<i>Charadrius veredus</i>	Oriental plover	A
38	<i>Calidris alba</i>	Sanderling	N
39	<i>Calidris ferruginea</i>	Curlew sandpiper	A & N
40	<i>Calidris minuta</i>	Little stint	A & N?
41	<i>Calidris subminuta</i>	Long toed stint	Unknown
42	<i>Calidris tenuirostris</i>	Great knot	A
43	<i>Caloenas nicobarica</i>	Nicobar pigeon	A & N- R
44	<i>Caprimulgus macrurus</i>	Large tailed night jar	A
45	<i>Casmerodius albus</i>	Great egret	A
46	<i>Centropus andamensis</i> *	Brown coucal	A- Nt
47	<i>Cetti pallidipes</i>	Palefooted bush warbler	A
48	<i>Ceyx erithacus</i>	Oriental dwarf kingfisher	A & N
49	<i>Chalciles maculatus</i>	Asian emerald cuckoo	A & N-V
50	<i>Chalcophaps indica</i>	Emerald dove	A
51	<i>Chandrius asiaticus veredus</i>	Caspian plover	A- V
52	<i>Charadrius dubius</i>	Little ringed plover	A
53	<i>Charadrius mongolus</i>	Lesser sand plover	A & N- R
54	<i>Charadrius leschenaulti</i>	Greater sand plover	A & N
55	<i>Chlidonias leucopterus</i>	White winged tern	A
56	<i>Chrysococcyx maculatus</i>	Asian emerald cuckoo	A & N-V
57	<i>Circus aeruginosus</i>	Eurasian marsh harrier	A
58	<i>Circus macrourus</i> (Gmelin)	Pallid harrier	A
59	<i>Circus pygargus</i>	Montagu's harrier	A
60	<i>Cisticola juncidis</i>	Sitting cisticola	A
61	<i>Collocalia brevirostris</i>	Himalayan swiftlet	A
62	<i>Collocalia esculenta</i> *	Glossy swiftlet	A & N
63	<i>Collocalia fuciphaga</i> *	Edible nest swiftlet	A & N
64	<i>Columba palumboides</i> *	Andaman wood pigeon	A & N- NT
65	<i>Copsychus malabaricus</i>	White rumped shama	A- R
66	<i>Copsychus saularis andamensis</i> (Hume) *	Andaman magpie robin	A
67	<i>Coracina macei</i>	Large cuckoo shrike	A
68	<i>Coracina macei</i>	Large cuckoo shrike	A
69	<i>Coracina striata</i>	Bar bellied cuckoo shrike	A
70	<i>Corvus macrorhynchos</i>	Large billed crow	A- R
71	<i>Cuculus micropterus</i>	Indian cuckoo	A & N- R
72	<i>Cuculus poliocephalus</i>	Lesser cuckoo	A- R
73	<i>Cuculus saturatus</i>	Oriental cuckoo	A & N- V
74	<i>Dendroanthus indicus</i>	Forest wagtail	A
75	<i>Dendrocitta bayleyi</i> *	Andaman tree pic	A- NT
76	<i>Dendrocopos macei</i>	Fulvous breasted woodpecker	A- R
77	<i>Dendrocygna javanica</i>	Lesser whistling duck	A & N- R
78	<i>Dicaeum concolor virescens</i>	Plain coloured flowerpecker	A
79	<i>Dicrurus andamensis</i> *	Andaman drongo	A- NT
80	<i>Dicrurus caeruleus</i>	Crow billed drongo	N
81	<i>Dicrurus macrocerus</i>	Black drongo	A & N-
82	<i>Dicrurus paradiseus</i>	Greater racket tailed drongo	A & N- R

83	<i>Dromas ardeola</i>	Crab plover	A & N
84	<i>Dromas ardeola</i>	Crab plover	A & N- Visitor
85	<i>Dryocopus hodgei</i> *	Andaman woodpecker	A- NT
86	<i>Dryocopus hodgei</i>	Andaman wood pecker	A- R
87	<i>Ducula aenea</i>	Green imperial pigeon	A- R
88	<i>Ducula bicolor</i>	Pied imperial pigeon	N- R
89	<i>Egretta garzetta</i>	Little egret	A & N- R
90	<i>Egretta sacra</i>	Pacific reef heron	A & N
91	<i>Emberiza aureola</i>	Yellow breasted bunting	
92	<i>Embertza pusilla</i> (Pallas) *	Little bunting	A
93	<i>Emberiza rutila</i>	Chestnut bunting	
94	<i>Exacus neglectus</i> *	Australian stone plover	A
95	<i>Exacus neglectus</i>	Beach thick knee	A
96	<i>Eudynamis scolopacea</i>	Asian koel	A & N
97	<i>Eurystomus orientalis</i>	Dollarbird	A
98	<i>Falco peregrinus</i>	Peregrine falcon	A
99	<i>Ficedula parva</i>	Red throated flycatcher	A
100	<i>Fragata andrewsi</i>	Christmas island frigatebird	A
101	<i>Fregetta tropica</i>	Black bellied storm petrel	N
102	<i>Gallinix cinerea</i> (Gmelin)	Water cock	A & N
103	<i>Gallinago gallinago</i>	Common snipe	A- R
104	<i>Gallinago media</i>	Great snipe	A- R
105	<i>Gallinago stenura</i>	Pintail snipe	R
106	<i>Gallinago stenura</i>	Pintail snipe	A & N- R
107	<i>Gallinula chloropus</i>	Malayan moorhen	A
108	<i>Gallirallus striatus</i>	Salty breasted rail	A & N- R
109	<i>Glareola maldivarum</i>	Oriental pratincole	A & N
110	<i>Gracula religiosa</i>	Hill myna	A & N
111	<i>Halcyon capensis</i>	Stork billed kingfisher	A & N- R
112	<i>Halcyon cormandra</i>	Ruddy kingfisher	A- R
113	<i>Halcyon pileata</i>	Black capped kingfisher	R
114	<i>Halcyon syriensis</i>	Whitethroated kingfisher	A
115	<i>Haliaeetus leucogaster</i>	White bellied sea eagle	A & N- R
116	<i>Hirundapus giganteus</i>	Brown backed needletail	A- R
117	<i>Hirundo rustica</i>	Barn swallow	A & N
118	<i>Hirundo tahitica</i>	Pacific swallow	A
119	<i>Hypothymis azurea</i>	Blacknaped monarch	A
120	<i>Hypsipetes nicobarensis</i> *	Nicobar bulbul	N- Vu (CT)
121	<i>Irena puella</i>	Asian fairy blue bird	A & N
122	<i>Ixobrychus sinensis</i>	Yellow bittern	A & N- R
123	<i>Lalage nigra</i> *	Pied triller	A & N
124	<i>Lanius cristatus</i>	Brown shrike	A & N- R
125	<i>Limicola falcinellus</i>	Broad billed sandpiper	A & N
126	<i>Limosa lapponica</i>	Bar tailed godwit	A & N- R
127	<i>Locustella naevia</i>	Lanceolated warbler	
128	<i>Lonchura striata</i>	White rumped munia	
129	<i>Loriculus vernalis</i>	Vernal hanging parrot	A & N- R
130	<i>Luscinia cyane</i>	Siberian blue robin	A
131	<i>Lymnocyrtus minimus</i>	Jack snipe	A- R
132	<i>Macropygia rufipennis</i> *	Andaman cuckoo dove	A- N

133	<i>Megapodius nicobariensis</i> *	Nicobar scrubfowl	N- R- Vu
134	<i>Merops leschenaulti</i>	Chestnut headed bee eater	A- R
135	<i>Merops philippinus</i> (Linnacus)	Bluetailed bee-eater	A & N
136	<i>Motacilla alba</i>	White wagtail	R
137	<i>Motacilla cinerea</i>	Grey wagtail	
138	<i>Motacilla flava</i>	Yellow wagtail	R
139	<i>Muscicapa dauurica</i>	Brown flycatcher	A & N- R
140	<i>Nectarinia jugularis</i>	Olive backed sunbird	A
141	<i>Nettapus coromandelianus</i>	Cotton pygmy goose	A- R
142	<i>Ninox affinis</i> *	Andaman hawk owl	A- Ni
143	<i>Ninox scutulata</i>	Brown hawk owl	A & N- R
144	<i>Numenius arquata</i>	Eurasian curlew	A & N- R
145	<i>Numenius phaeopus</i>	Whimbrel	A & N- R
146	<i>Nycticorax nycticorax</i>	Black crowned night heron	R
147	<i>Oriolus chinensis</i>	Blacknaped oriole	A- R
148	<i>Oriolus oriolus</i>	Eurasian golden oriole	A
149	<i>Oriolus xanthornus</i>	Black hooded oriole	A
150	<i>Otus balli</i> (Hume)	Andaman scops owl	A
151	<i>Otus scops modestus</i> *	Andaman lesser scops owl	A
152	<i>Otus sunia</i>	Oriental scops owl	A & N? - R
153	<i>Pandion haliaetus</i>	Osprey	R
154	<i>Passer domesticus</i>	House sparrow	
155	<i>Passer montanus</i>	Eurasian tree sparrow	
156	<i>Pelecanus philippensis</i>	Spot billed pelican	A & N?
157	<i>Pericrocotus cinnamomeus</i>	Small minivet	A
158	<i>Pericrocotus flammeus</i>	Scarlet minivet	A- R
159	<i>Phaethon aethereus</i>	Red billed tropicbird	N
160	<i>Phaethon lepturus</i>	White tailed tropicbird	A
161	<i>Phaethon rubricauda</i>	Red tailed tropicbird	N
162	<i>Phylloscopus trochiloides</i>	Greenish warbler	A
163	<i>Phylloscopus borealis</i>	Arctic warbler	
164	<i>Phylloscopus fasciatus</i>	Dusky warbler	
165	<i>Phylloscopus inornatus</i>	Yellow browed warbler	
166	<i>Phylloscopus magnirostris</i>	Large billed leaf warbler	
167	<i>Phylloscopus tenellipes</i>	Pale legged leaf warbler	
168	<i>Pitta sordida</i>	Hooded pitta	N
169	<i>Pluvialis fulva</i>	Pacific golden plover	A & N
170	<i>Pluvialis fulva</i>	Pacific golden plover	A & N
171	<i>Pluvialis squatarola</i>	Grey plover	A & N
172	<i>Pluvialis squatarola</i> (Linnaeus)	Grey plover	A & N
173	<i>Porphyrio porphyrio</i>	Purple swamphen	A & N- R
174	<i>Porzana parva</i>	Little crane	A- V
175	<i>Porzana pusilla</i>	Baillon's crane	A- V
176	<i>Psittacula alexandri</i> *	Red breasted parakeet	A
177	<i>Psittacula caniceps</i> *	Nicobar parakeet	N- R- Ni
178	<i>Psittacula eupatria</i>	Alexandrine parakeet	A
179	<i>Psittacula eupatria</i>	Alexandrine parakeet	
180	<i>Psittacula longicauda</i>	Long tailed parakeet	A- R
181	<i>Psittacula longicauda</i>	Long tailed parakeet	A & N- R
182	<i>Pycnonotus atripus</i>	Blackheaded bulbul	A

183	<i>Pycnonotus jacobus</i>	Red whiskered bulbul	A- R
184	<i>Rallina cinnamomea</i> (Blyth) *	Andaman banded orake	A- UV
185	<i>Rhinomyias brunneata</i>	Brown chested jungle flycatcher	N
186	<i>Saxicola torquata</i>	Common stone chat	A
187	<i>Scolopax rusticola</i>	Eurasian woodcock	A- R
188	<i>Spilornis cheela</i>	Crested serpent eagle	A & N
189	<i>Spilornis elgini</i>	Andaman serpent eagle	A
190	<i>Spilornis minimus</i> *	Small serpent eagle	N- Nt
191	<i>Spizaetus cirrhatus</i>	Changeable hawk eagle	A
192	<i>Spilornis elgini</i> (Blyth) *	Andaman serpent eagle	A- Nt
193	<i>Sterna albitrons</i>	Little tern	A
194	<i>Sterna anachetus</i>	Bridled tern	A
195	<i>Sterna bengalensis</i>	Lesser crested tern	R
196	<i>Sterna bergii</i>	Great crested tern	N
197	<i>Sterna dougalli</i>	Roseate tern	A
198	<i>Sterna fuscata</i>	Sooty tern	R
199	<i>Sterna sumatrana</i>	Blacknapped tern	A & N
200	<i>Streptopelia tranquebarica</i>	Red collared dove	A
201	<i>Sturnus roseus</i>	Rosy starling	A
202	<i>Sturnus sturninus</i>	Purple backed sunbird	A & N
203	<i>Sturnus erythropygius</i> *	Whiteheaded starling	A- Nt
204	<i>Tadorna ferruginea</i>	Ruddy shelduck	A- R
205	<i>Terpsiphone paradisi</i>	Asian paradise flycatcher	N
206	<i>Todiramphus chloris</i>	Collared kingfisher	A- R
207	<i>Treron bicincta</i>	Pompadour green pigeon	A & N- R
208	<i>Tringa glareola</i>	Wood sandpiper	A & N
209	<i>Tringa glareola</i>	Wood sandpiper	A- R
210	<i>Tringa ochropus</i>	Green sandpiper	A- R
211	<i>Tringa totanus</i>	Common redshank	A & N
212	<i>Tringa totanus</i>	Common redshank	A & N- R
213	<i>Trichus obscurus</i>	Eyebrowed thrush	A
214	<i>Tyto alba</i>	Barn owl	A
215	<i>Vanellus cinereus</i>	Grey headed lapwing	A
216	<i>Xenus cinereus</i>	Terek sandpiper	A & N
217	<i>Zoothera citrina</i> *	Orange headed thrush	A
218	<i>Zosterops palpebrosa</i> *	Oriental white eye	A & N

Source: BNHS, ZSI, SACON, Birdlife International (2000)

* - Endemic; A - Andamans; N - Nicobars; R - Resident; V - Visitor; Nt - near threatened; Vu - vulnerable; DD - data deficient.

12. 4. Appendix 4: Amphibian fauna in ANI

	Family	Species	Distribution
1	Bufo	<i>Bufo melanostictus</i>	A & N
2	Microhylidae	<i>Kaloula baleata ghoshii</i> *	A
3		<i>Micriletta inornata</i>	A
4		<i>Microhyla ornata</i>	A
5		<i>Microhyla chakrapani</i> *	A
6		<i>Microhyla heymonsi</i>	N
7	Ranidae	<i>Limnonectes andamanensis</i> *	A
8		<i>Limnonectes doriae</i>	A & N
9		<i>Limnonectes limnocharis</i> *	A
10		<i>Limnonectes sp. 1</i> *	A
11		<i>Limnonectes sp. 2</i> *	A
12		<i>Limnonectes shompenorum</i> *	N
13		<i>Limnonectes cancrivorus</i>	N
14		<i>Limnonectes aff. limnocharis</i>	N
15		<i>Rana charlesdarwini</i>	A
16		<i>Rana nicobariensis</i>	N
17		<i>Rana erythraea</i>	N
18		<i>Rana chalconota</i>	N
19		<i>Taylorana hascheana</i>	A & N
20	Rhacophoridae	<i>Polypedates insularis</i> *	N

Source: Das, 1995, 1999, 2002.

* Endemic species recognised at present indicated with an asterisk

12. 5. Appendix 5: Reptile fauna in ANI

	Family	Species	Distribution & Status
1	Crocodylidae	<i>Crocodylus porosus</i>	A & N- En
2	Dermochelyidae	<i>Dermochelys coriacea</i>	A & N-En
3	Cheloniidae	<i>Chelonia mydas</i>	A & N-En
4		<i>Eretmochelys imbricata</i>	A & N-En
5		<i>Lepidochelys olivacea</i>	A & N-En
6	Bataguridae	<i>Cuora ambauensis</i>	N-DD
7	Gekkonidae	<i>Cnemaspis aff. kandianus</i> *	A & N
8		<i>Cosymbotus aff. platyrus</i> *	A & N
9		<i>Cyrtodactylus rubidus</i> *	A
10		<i>Cyrtodactylus adleri</i> *	N
11		<i>Gehyra mutilata</i>	A & N
12		<i>Gekko verreauxi</i> *	A
13		<i>Gekko smithii</i>	N
14		<i>Hemidactylus frenatus</i>	A & N
15		<i>Hemiphyllodactylus typus</i>	N
16		<i>Lepidodactylus lugubris</i>	A
17		<i>Phelsuma andamanense</i>	A
18		<i>Pychozaon kuhli</i>	N
19	Agamidae	<i>Bronchocela cristatella</i> *	N
20		<i>Bronchocela danieli</i> *	N
21		<i>Calotes versicolor</i>	A-Introduced sp.
22		<i>Coryphophylax subcristatus</i> *	A&N
23	Scincidae	<i>Dasia nicobarensis</i> *	N

24		<i>Dasia olivacea</i>	N
25		<i>Lipinia macrotympana</i> *	A & N
26		<i>Lygosoma aff. bowringii</i> *	A
27		<i>Mabuia andamanensis</i> *	A
28		<i>Mabuia radis</i>	N
29		<i>Mabuia tyleri</i> *	A
30		<i>Scincella macrotis</i> *	N
31		<i>Sphenomorphus maculatus</i>	A & N
32	Varanidae	<i>Varanus salvator andamanensis</i> *	A - En
33		<i>Varanus salvator nicobariense</i> *	N-En
33	Dibamidae	<i>Dibamus nicobaricus</i> *	N
34	Typhlopidae	<i>Ramphotyphlops braminus</i>	A & N
35		<i>Typhlops andamanensis</i>	A
36		<i>Typhlops oatesi</i>	A
37	Acrochordidae	<i>Acrochordus granulatus</i>	A & N
38	Xenopeltidae	<i>Xenopeltis unicolor</i>	N
39	Colubridae	<i>Amphiesma nicobariense</i> *	N
40		<i>Boiga andamanensis</i> *	A
41		<i>Boiga cyanea</i>	N
42		<i>Boiga ochracea</i>	A
43		<i>Boiga wallachi</i> *	N
44		<i>Cantoria violacea</i>	A
45		<i>Cerberus rynchops</i>	A & N
46		<i>Chrysopelea paradise</i>	A
47		<i>Dendrelaphis cyanochloris</i>	A
48		<i>Dendrelaphis pictus andamanensis</i> *	N
49		<i>Elaphe flavolineata</i>	A
50		<i>Gonyosoma oxycephalum</i>	A
51		<i>Gongylosoma nicobarense</i> *	N
52		<i>Lycodon capucinus</i>	A
53		<i>Lycodon inornatus</i> *	A
54		<i>Oligodon nicobarense</i> *	N
55		<i>Sibynophis bistrigatus</i> †	N
56		<i>Xenochrophis melanostictus</i>	A & N
57		<i>Xenochrophis trianguligerus</i>	N
59	Boidae	<i>Python reticulatus</i>	N-DD
59	Hydrophiidae	<i>Hydrophis cantoris</i>	A
60		<i>Laticauda colubrina</i>	A & N
61		<i>Laticauda laticaudata</i>	A
62		<i>Pelamis platurus</i>	A & N
63	Viperidae	<i>Trimeresurus andersoni</i> *	A
64		<i>Trimeresurus cantorii</i> *	N
65		<i>Trimeresurus labialis</i> *	N
66	Elapidae	<i>Bungarus andamanensis</i> *	A
67		<i>Naja sagittifera</i> *	A-En
68		<i>Ophiophagus hannah</i>	A-En

Source: Das, 1999.

† Nicobar record in need of confirmation, according to Smith (1943: 280); *Endemic species recognised at present indicated with an asterisk
A - Andamans; N - Nicobars; * - Endemic; C - Critical; En - endangered; Vu - vulnerable; LRnt - lower risk near threatened;
Dd - data deficient.

12. 6. Appendix 6: Endemic plants known from ANI

The presence of over 2000 indigenous and 500 non-indigenous angiosperm species within a land area of 8290 sq km is a significant feature of the islands, making them a cynosure not only for plant taxonomists but also for conservationists. Of the 2000 species known 14% are endemic. At the generic level endemism is rather less with only three genera viz. *Sphyranthra* (Euphorbiaceae) with 2 species, *Pubistylis* (Rubiaceae) with one species and *Nicobariodendron* (Celastraceae) with one species (Rao, 1996).

	Family	Species	Gt. Nic.	Nic. Is.	ANI
1	Pteridophytes				
2	Cyatheaceae	<i>Cyathea albasetacea</i>	A	P	A
3		<i>Cyathea nicobarica</i>	A	P	A
	Dicotyledons				
4	Ranunculaceae	<i>Clematis smilacifolia</i> var. <i>andamanica</i>	A	A	P
5	Dilleniaceae	<i>Dillenia andamanica</i>	A	A	P
6	Annonaceae	<i>Artobotrys nicobarianus</i>	P	A	A
7		<i>Friesodielsia forniculata</i>	P	A	A
8		<i>Orophea katschallica</i>	A	A	P
9		<i>Polyalthia parkinsonii</i>	A	A	P
10		<i>Pseuduvaria prainii</i>	A	A	P
11		<i>Uvaria nicobarica</i>	P	A	A
12	Menispermaceae	<i>Cyclea pendulina</i>	A	A	P
13	Sterculiaceae	<i>Stereulia cordata</i>	A	A	P
14	Clusiaceae	<i>Grewia calophylla</i>	A	A	P
15	Rutaceae	<i>Glycosmis pilosa</i>	A	A	P
16		<i>G. mauritiana</i> var. <i>andamanensis</i>	A	A	P
17		<i>Paramignya andamanica</i>	A	A	P
18	Meliaceae	<i>Chisocheton nicobaricus</i>	P	A	A
19		<i>Dysoxylum alliaceum</i>	A	A	P
20	Icacinaceae	<i>Codiocarpus andamanica</i>	A	A	P
21		<i>Gomphandra comosa</i>	A	P	A
22	Celastraceae	<i>Nicobariodendro sleumeri</i>	P	A	A
23	Vitaceae	<i>Tetrastigma andamanica</i>	A	A	P
24		<i>Leea grandifolia</i>	A	P	A
25	Anacardiaceae	<i>Mangifera nicobarica</i>	A	P	A
26		<i>Semecarpus kurzii</i>	A	A	P
27	Connaraceae	<i>Connarus nicobaricus</i>	P	A	A
28	Combretaceae	<i>Terminalia procera</i>	A	A	P
29	Melastomataceae	<i>Otanthra nicobarensis</i>	P	A	A
30	Memecylaceae	<i>Memecylon andamanicum</i>	A	A	P
31	Rubiaceae	<i>Coptophyllum nicobaricum</i>	P	A	A
32		<i>Hedyotis paradoxa</i>	A	A	P
33		<i>Ixora brunnescens</i>	A	A	P
34		<i>I. cuneifolia</i> var. <i>macrocarpa</i>	A	P	A
35		<i>I. grandifolia</i> var. <i>kurzlana</i>	A	P	A
36		<i>I. grandifolia</i> var. <i>rosella</i>	A	P	A
37		<i>I. tenuifolia</i>	A	P	A

38		<i>Ophiorrhiza infundibularis</i>	P	A	A
39		<i>O. nicobarica</i>	P	A	A
40		<i>Psychotria andamanica</i>	A	A	P
41		<i>P. platyneura</i>	A	P	A
42		<i>Tarenna weberaeifolia</i>	A	A	P
43	Myrsinaceae	<i>Embelia microcalyx</i>	A	P	A
44		<i>Maesa andamanica</i>	A	A	P
45	Oleaceae	<i>Jasminum multiflorum</i> var. <i>nicobaricum</i>	P	A	A
46	Apocynaceae	<i>Aislonia kurzii</i>	A	A	P
47		<i>Chilocarpus denudatus</i> var. <i>nicobaricus</i>	P	A	A
48		<i>Tabernaemontana crispa</i>	A	A	P
49	Asclepiadaceae	<i>Gemianthus horei</i>	P	A	A
50	Scrophulariaceae	<i>Cyrtandroemia nicobarica</i>	P	A	A
51	Gesneriaceae	<i>Cyrtandra burtii</i>	P	A	A
52		<i>C. occidentalis</i>	P	A	A
53	Acanthaceae	<i>Strobilanthes glanchulosus</i>	A	A	P
54	Myrsinaceae	<i>Knema andamanica</i> spp. <i>andamanica</i>	A	A	P
55	Lauraceae	<i>Litsea kurzii</i>	A	P	A
56		<i>Nothophoebe nicobaricus</i>	P	A	A
57	Euphorbiaceae	<i>Claoxylon rostratum</i>	A	A	P
58		<i>Cleistanthus balakrish</i>	P	A	A
59		<i>Drypetes bhattacharyae</i>	A	A	P
60		<i>Glochidion calocarpw</i>	A	A	P
61		<i>Macaranga nicobarica</i>	A	P	A
62		<i>Mallotus oblongifolius</i> var. <i>rubriflorus</i>	A	A	P
63		<i>Sphyranthra lutescen</i>	A	A	P
64		<i>Trigonostemon villosus</i> var. <i>nicobaricus</i>	P	A	A
65	Urticaceae	<i>Pellionia praeclidifolia</i>	A	P	A
66		<i>Elatostema novorae</i>	A	P	A
Monocotyledons					
67	Orchidaceae	<i>Aerides emericii</i>	P	A	A
68		<i>Anoctochilus nicobar</i>	P	A	A
69		<i>Eria bractescens</i> var. <i>kurzii</i>	A	A	P
70		<i>Dendrobium stompemii</i>	P	A	A
71		<i>Pomatocalpa andamanicum</i>	A	A	P
72		<i>Phalaenopsis speciosa</i> var. <i>speciosa</i>	A	A	P
73		<i>Trichoglottis quadricornuta</i>	A	P	A
74		<i>Vanilla andamanica</i>	A	A	P
75	Zingiberaceae	<i>Hornstedtia fenizii</i>	P	A	A
76	Marantaceae	<i>Phrynium paniculatum</i>	P	A	A
77	Dioscoreaceae	<i>Dioscorea vexans</i>	A	A	P
78	Agavaceae	<i>Dracaena brachyphylla</i>	A	A	P
79	Arecaceae	<i>Calamus andamanicus</i>	A	A	P
80		<i>C. dilaceratus</i>	A	P	A

81		<i>C. pseudo-rivalis</i>	A	A	P
82		<i>C. uniforms</i>	A	P	A
83		<i>C. nicobaricus</i>	P	A	A
84		<i>Pinanga manii</i>	A	A	P
85		<i>Rhopaloblaste augustata</i>	P	A	A
86	Pandanaceae	<i>Pandanus lerram</i> <i>var. andamanensis</i>	A	A	P
87	Araceae	<i>Aglaonema nicobaricum</i>	P	A	A
88		<i>Homalomena griffithii</i> var. <i>ovata</i>	P	A	A

Source: Rao (1999)

12. 7. Appendix 7: Butterfly species in ANI

	Family	Scientific name	A	N
1	Papilionidae	<i>Atrophaneura aristolochiae kondulana</i> *		+
2		<i>Atrophaneura coon samblanga</i> *	+	+
3		<i>Atrophaneura rhodifer</i> *	+	
4		<i>Chilasa clytio flavolimbatus</i>		
5		<i>Graphium agamemnon andamana</i> *	+	
6		<i>Graphium agamemnon decoratus</i> *		+
7		<i>Graphium epaminondas</i> *	+	
8		<i>Graphium agamemnon pula</i> *		+
9		<i>Graphium antipathes epaminondas</i>	+	
10		<i>Graphium euryptylus macronus</i>	+	
11		<i>Pachliopta aristolochia aristolochia</i>	+	
12		<i>Pachliopta aristolochia ceylonicus</i>	+	
13		<i>Pachliopta aristolochia goniopeltis</i>	+	
14		<i>Pachliopta coon rhodifer</i>	+	
15		<i>Pachliopta hector</i>		+
16		<i>Pachliopta sawi</i>		
17		<i>Pachliopta aristolochia camorta</i>		
18		<i>Pachliopta aristolochia kondulana</i>		
19		<i>Papilio demoleus demoleus</i>		
20		<i>Papilio fuscus andamanicus</i> *		
21		<i>Papilio mayo</i> *	+	
22		<i>Papilio memnon agenor</i>	+	+
23		<i>Papilio polytes stichoides</i>		
24		<i>Papilio polytes nikobarus</i> *		+
25		<i>Troides helena cereberus</i>	+	
26		<i>Troides helena ferrari</i> *		+
27		<i>Troides helena heliconoides</i>	+	
28	Pieridae	<i>Anaphaeis aurota aurota</i>		+
29		<i>Appias albina darada</i>	+	
30		<i>Appias libythea oferna</i>		
31		<i>Appias lyncida galbana</i>		
32		<i>Appias lyncida nicobarica</i> *		+
33		<i>Appias paulina galathea</i> *		+
34		<i>Catopsilia pomona</i>	+	+

35	<i>Catopsilia pyranthe</i> (incl. f. <i>florella</i>)	+	
36	<i>Catopsilia florella</i> <i>gnoma</i>	+	+
37	<i>Catopsilia crocale</i> <i>crocale</i>	+	
38	<i>Cepora nodina</i> <i>andamana</i> *	+	+
39	<i>Cepora nerissa</i> <i>depha</i>	+	+
40	<i>Cepora nerissa</i> <i>lichenasa</i>	+	+
41	<i>Candaca harina</i> <i>andamana</i> *	!	
42	<i>Dellias hyparete</i> <i>indica</i>	+	
43	<i>Eurema andersoni</i> <i>evansi</i>		
44	<i>Eurema blanda</i> <i>grisea</i> *		+
45	<i>Eurema blanda</i> <i>moorei</i>		
46	<i>Eurema blanda</i> <i>silhetana</i>	+	
47	<i>Eurema brigitta</i> <i>rubella</i>		
48	<i>Eurema hecabe</i> <i>blatana</i>	+	
49	<i>Eurema hecabe</i> <i>nicobariensis</i> *		+
50	<i>Eurema laeta</i> <i>laeta</i>	+	+
51	<i>Gandaca harina</i> <i>andamana</i>	+	
52	<i>Gandaca harina</i> <i>nicobarica</i> *	+	+
53	<i>Hebomoia glaucippe</i> <i>roepstrof</i>	+	
54	<i>Ixias pyrene</i> <i>andamana</i> *	+	
55	<i>Leptosia nina</i> <i>nina</i>	+	
56	<i>Leptosia nina</i> <i>nicobarica</i> *		+
57	<i>Parevnia ceylanica</i> <i>naraka</i>	+	
58	<i>Saletara panda</i> <i>chrysea</i> *		+
59	Lycaenidae <i>Amblypodia anita</i> <i>andamanica</i> *	+	
60	<i>Anthene emolus</i> <i>andamanicus</i> *		
61	<i>Anthene lycaenina</i> <i>lycambes</i>		
62	<i>Arhopala alea</i> <i>constanceae</i>		
63	<i>Arhopala alesia</i>		
64	<i>Arhopala asopoia</i> <i>asopia</i>		
65	<i>Arhopala centaurus</i> <i>coruscans</i> *	+	
66	<i>Arhopala fulla</i> <i>andamanica</i> *	+	
67	<i>Arhopala zeta</i>	+	
68	<i>Artipe erys</i>	+	
69	<i>Bindahara phocides</i> <i>phocides</i>		
70	<i>Bindahara phocides</i> <i>areca</i> *		+
71	<i>Caleta elna</i> <i>noliteia</i>	+	
72	<i>Caleta roxus</i> <i>roxus</i>		
73	<i>Caleta roxus</i> <i>manhuena</i>		+
74	<i>Castalius rosomon</i> <i>alarbus</i> *	+	+
75	<i>Castalius ethion</i> <i>airavati</i> *		+
76	<i>Catochrysops lithargyros</i>	+	+
77	<i>Catochrysops sirabo</i>	+	+
78	<i>Catochrysops lithargyria</i>	+	
79	<i>Charana jalindra</i> <i>tarpina</i> *	+	
80	<i>Charana mandarinus</i>		

81	<i>Chiliaria othona</i>		
82	<i>Curetis saronis saronis</i>		
83	<i>Curetis saronis kondulana</i>		
84	<i>Curetis saronis nicobarica</i> *		+
85	<i>Curetis saronis obscura</i>		
86	<i>Deudorix epijarbas amatius</i>	+	+
87	<i>Discolampa ethion ethion</i>	+	
88	<i>Discolampa ethion airavati</i>		
89	<i>Euchrysops cnejus</i>	+	+
90	<i>Euchrysops pandava pandava</i>	+	+
91	<i>Eneres parthasius pila</i> *		!
92	<i>Heliophorus epicles indicus</i>		
93	<i>Horaga albimacula</i>		
94	<i>Horaga onyx rana</i>		
95	<i>Hypolycaena erylus andaman</i> *	+	
96	<i>Hypolycaena thectoides nicobarica</i> *		+
97	<i>Ionolyce helicon brunnea</i> *	+	
98	<i>Ionolyce helicon kondulana</i>		
99	<i>Iraota timoleon timoleon</i>		
100	<i>Jamides alecto fusca</i>		
101	<i>Jamides alecto kondulana</i> *		+
102	<i>Jamides bochus bochus</i>	+	
103	<i>Jamides bochus nicobaricus</i> *		+
104	<i>Jamides celeno blairana</i> *	+	
105	<i>Jamides celeno kinkurka</i>		
106	<i>Jamides celeno nicevillei</i> *		+
107	<i>Jamides ferrari</i>		
108	<i>Jamides kankena kankena</i> *		+
109	<i>Jamides kankena pseudelpis</i>		
110	<i>Lampides boeticus</i>		
111	<i>Loxura atymnus nicobarica</i> *	+	+
112	<i>Loxura atymnus prabha</i>	+	
113	<i>Lycanopsis puspa cyanescens</i>		
114	<i>Lycanopsis puspa telis</i> *	+	
115	<i>Lycanopsis puspa prominens</i> *		!
116	<i>Megisha malaya presbyter</i> *		+
117	<i>Megisha malaya sikkima</i>		
118	<i>Nacaduba ancyra aberrans</i>		
119	<i>Nacaduba berenice nicobarica</i> *		
120	<i>Nacaduba hermus major</i> *		+
121	<i>Nacaduba kurava euplea</i>	+	
122	<i>Nacaduba kurava nicobarica</i> *		+
123	<i>Nacaduba pactolus andamanica</i> *		
124	<i>Nacaduba pactolus macrothalma</i> *		+
125	<i>Nacaduba pavana</i>	+	
126	<i>Nacaduba vajuvu varia</i> *		+

127		<i>Nacaduba nora dilate</i> *		+
128		<i>Neopithecops zalmora</i>	+	
129		<i>Narathura arhopalae zeta</i> *	+	
130		<i>Perlaea dana</i>		
131		<i>Pratapa deva lila</i>		
132		<i>Prosotas aluta coelestis</i>		
133		<i>Prosotas dubiosa fulva</i>		
134		<i>Prosotas nora nora</i>		
135		<i>Prosotas nora dilate</i>		
136		<i>Rapala dieneces intermedia</i>		
137		<i>Rapala schistaceae</i>		
138		<i>Rapala suffuse rubicunda</i> *	+	
139		<i>Rapal varuna orceis</i>		
140		<i>Spalgis epius nubilus</i> *	+	+
141		<i>Spalgis epius epius</i>		+
142		<i>Spindasis lohita zoilus</i>		
143		<i>Surendra quercetorum latimargo</i> *	+	
144		<i>Tajuria jangala andamanica</i> *	+	
145		<i>Tajuria cippus cippus</i>		
146		<i>Zaoceria kansandra</i>		
147		<i>Zizina otis otis</i>	+	+
148		<i>Zizula gaika</i>	+	+
149		<i>Zizula hylax</i>		+
150	Riodinidae	<i>Abisara echerius bifasciata</i> *	+	
151	Nymphalidae	<i>Amathusia phidippus andamanensis</i> *	+	
152		<i>Atella alcippe andamana</i> *	+	
153		<i>Atella alcippe fraternal</i> *		+
154		<i>Athyma nefte rufula</i>		
155		<i>Cethosia biblis andamana</i> *	+	
156		<i>Cethosia biblis nicobarica</i> *	+	+
157		<i>Cethosia bibles anihada</i> *	+	
158		<i>Charaxes bernardus agna</i>		
159		<i>Cirrochroa fasciata</i>		
160		<i>Cirrochroa nicobarica</i> *		+
161		<i>Cirrochroa tyche anjira</i> *	+	
162		<i>Cupha erymanthis andamanica</i> *	+	
163		<i>Cupha erymanthis nicobarica</i> *		+
164		<i>Cythia erota pallidais</i> *	+	
165		<i>Cyrestis cocles formosa</i> *		
166		<i>Cyrestis tabula</i> *		+
167		<i>Cyrestis thyodamas andamanica</i> *	+	
168		<i>Danaus affinis malayana</i>		
169		<i>Danaus genutia genutia</i>	+	+
170		<i>Danaus melanipus camoria</i>	+	+
171		<i>Discophora timora andamanensis</i> *	+	
172		<i>Doleschallia bisaltide andamana</i> *	+	+

173	<i>Elymnias cottonis cottonis</i> *	+	
174	<i>Euploea core andamanensis</i> *	+	
175	<i>Euploea core bumila</i>	+	
176	<i>Euploea core camorta</i>		
177	<i>Euploea core scherzeri</i>		+
178	<i>Euploea crameri esperi</i>		
179	<i>Euploea leucostictos novarae</i>		
180	<i>Euploea midamus chloe</i>		
181	<i>Euploea midamus roepstorffi</i>		
182	<i>Euploea muleiber muleiber</i>		
183	<i>Euploea phaenareta phoebus</i>		
184	<i>Euploea sylvester harrisi</i>		
185	<i>Euripus consimilis consimilis</i>		
186	<i>Euthalia aconthea acontius</i> *	+	
187	<i>Euthalia cibaritis</i> *	+	
188	<i>Euthalia teuta tentoides</i> *	+	
189	<i>Herona marathus andamana</i> *		
190	<i>Hypolimnas antilope anomala</i> *		+
191	<i>Hypolimnas bolina jacintha</i>	+	+
192	<i>Hypolimnas misippus</i>	+	+
193	<i>Kallina albofasciata</i>		
194	<i>Laringa horsfieldii andamanensis</i>		
195	<i>Lethe europa nudgara</i> *	+	
196	<i>Melanitis zetes andamanica</i>		
197	<i>Moduza procris anarta</i> *		+
198	<i>Mycalesis anaxias radza</i>		
199	<i>Neptis columbia kankana</i> *		+
200	<i>Neptis ebusa ebusa</i>		
201	<i>Neptis hylas andamana</i> *	+	
202	<i>Neptis hylas nicobarica</i> *		+
203	<i>Neptis hylas sambilanga</i>		+
204	<i>Neptis jumbah amorasca</i> *	+	
205	<i>Neptis jumbah binghami</i>		
206	<i>Neptis nandina clinia</i> *	+	
207	<i>Neptis sankara nar</i>		
208	<i>Neptis soma mananda</i> *	+	
209	<i>Orsotrioena medus medus</i>	+	
210	<i>Orsotrioena medus nicobarica</i> *		
211	<i>Orsotrioena medus rylenea</i>		+
212	<i>Pantoporia hardomia cnacalis</i>	+	
213	<i>Pantoporia efie rufula</i> *	+	
214	<i>Parantica anglea agleoides</i>		
215	<i>Parantica anglea melanoleuca</i>	+	+
216	<i>Parantica melaneus plateniston</i>		
217	<i>Parantica nilgiriensis</i>		+
218	<i>Parthenos sylvia roepstorffi</i> *	+	

219		<i>Parthenos sylvia nila</i> *		+
220		<i>Phalanta phalanta phalanta</i>		
221		<i>Polyura athamas andamanicus</i> *	+	
222		<i>Polyura schreiber isamemus</i>		
223		<i>Precis almana almana</i>	+	
224		<i>Precis almana nicobariensis</i> *		+
225		<i>Precis atlites</i>	+	+
226		<i>Precis hierta magna</i>	+	
227		<i>Precis oritya ocyale</i>		+
228		<i>Precis lemonias</i>		
229		<i>Tirumala limniace exoticus</i>	+	+
230		<i>Vanessa cardui cardui</i>	+	
231		<i>Vindula erota pallida</i> *	+	
232		<i>Yoma sabina vasuki</i>		
233	Danaidae	<i>Danaus plexippus plexippus</i>		+
234		<i>Danaus melanipus nessipus</i> *		+
235		<i>Danaus gautama gautamoides</i> *		+
236		<i>Danaus aglea agleoides</i>		+
237		<i>Danaus nilgiriensis</i>		+
238		<i>Danaus similis nicobarica</i> *		+
239		<i>Danaus chrysippus chrysippus</i>	+	+
240		<i>Euploea core simulatrix</i> *		+
241		<i>Euploea crameri frauenfeldii</i> *		+
242		<i>Euploea andamanensis humila</i> *	+	
243		<i>Idea agamarschana cadelli</i> *	+	
244		<i>Radena similis nicobarica</i> *		+
245		<i>Tirumala limniace limniace</i>	+	+
246		<i>Tirumala septentrionis septentrionis</i>	+	+
247	Satyridae	<i>Elymnias panthera mimus</i> *		+
248		<i>Melanitis leda ismene</i>	+	+
249		<i>Mycalesis anaxias manii</i> *		+
250		<i>Mycalesis mineus nicobarica</i> *	+	+
251		<i>Mycalesis visala andamana</i> *	+	
252		<i>Lethe europa tamuna</i> *		+
253	Hesperiidae	<i>Astictopterus jama permagnus</i>		
254		<i>Baoris cahira cahira</i>		
255		<i>Baoris oceia scopulifera</i> *	+	
256		<i>Baoris farri scopulifera</i>	+	
257		<i>Bibasis amara</i>		
258		<i>Bibasis sena sena</i>		
259		<i>Borbo cinnara</i>	+	
260		<i>Calaenorrhinus andamanica</i> *		
261		<i>Calaenorrhinus leucocera leucocera</i>		
262		<i>Cephenes palmarum nicobarica</i> *		+
263		<i>Cupitha purrea</i>		
264		<i>Damio bhagava andamanica</i> *		+

265	<i>Erionata thrax acroleuca</i> *	+	+
266	<i>Gangara thyrus yasodara</i> *	+	+
267	<i>Hasora badra badra</i>	+	+
268	<i>Hasora chromus chromus</i>		
269	<i>Hasora leucospila parnia</i>		
270	<i>Hasora salanga</i>		
271	<i>Hasora taminatus almea</i>		+
272	<i>Hasora malayana</i>		
273	<i>Hasora vitta vitta</i>		
274	<i>Hyaotlis adrastus praba</i>	+	
275	<i>Ismene harisa harisa</i>		
276	<i>Ismene jama astigmata</i>		
277	<i>Natapa aria aria</i>		
278	<i>Natapa druna</i>	+	
279	<i>Natapa shalgrama</i>		
280	<i>Notocrypta curvifascia</i>	+	
281	<i>Notocrypta paralyxos paralyxos</i>		
282	<i>Oriens gola gola</i>	+	
283	<i>Padraona maesoides attalian</i> *	+	
284	<i>Paduka lebadae andamanica</i> *	+	
285	<i>Pelopidas conjuncta javana</i>		
286	<i>Pelopidas mathias mathias</i>	+	
287	<i>Pelopidas sp.</i>	+	
288	<i>Potanthus maesoides ottalina</i>	+	
289	<i>Potanthus serina serina</i>		
290	<i>Potanthus tropica nins</i> *	+	
291	<i>Potanthus trachala attalina</i>	+	
292	<i>Potanthus onfucius nina</i>	+	
293	<i>Sarangesa dasahara dasahara</i>		
294	<i>Suastus rama aditus</i>		
295	<i>Tagiades atticus helferi</i> *	+	+
296	<i>Tagiades atticus ravina</i> *	+	+
297	<i>Tagiades litigosa andamanica</i> *	+	
298	<i>Tagiades obscurus alica</i> *	+	
299	<i>Tagiades gana alica</i>	+	
300	<i>Tagiades japeus ravina</i>	+	
301	<i>Zographetus ogygia andamana</i> *	+	

Source: Evans (1932); Ferrar (1951; Khatri, 1989; 1990; 1993; 1994; 1997; 1998; Chandra & Khatri 1995.

* Endemic species recognised at present indicated with asterix; + Species recorded during the surveys A - Andamans; N - Nicobars

12. 8. Appendix 8: Mammalian species in ANI

	Family/Sub family	Scientific name	Common name & status
	Chiroptera		
1	Pteropodidae	<i>Cynopterus brachyotis</i>	Andman short nosed fruit bat- A & N- L Rnt
2		<i>Cynopterus spixi</i>	Common short nosed fruit bat- A- Dd
3		<i>Cynopterus sp.</i>	Unidentified- A (Aul, 2002)
4		<i>Eonycteris spelaea</i>	Cave fruit bat- A- Vu

5		<i>Pteropus fumulus</i> *	Nicobarese flying fox- N- Vu
6		<i>Pteropus giganteus</i>	Indian flying fox- A- En
7		<i>Pteropus melanotus tyleri</i>	Black flying fox- A & N- Dd
8		<i>Pteropus vampyrus</i>	Large flying fox- A- En
9		<i>Pteropus hypomelanus</i>	Island flying fox- A- En
10	Emballonuridae	<i>Taphazous melanopogon</i>	Black headed tomb bat- N- Dd
11		<i>Taphazous saccolaimus</i>	Pouch bearing bat- A
12	Megadermatidae	<i>Megaderma spasma</i>	Lesser false vampire bat- A- Dd
13	Rhinolophidae	<i>Rhinolophus affinis</i>	Intermediate horseshoe bat- A
14		<i>Rhinolophus cognatus</i>	Andamans horseshoe bat- A
15		<i>Rhinolophus refulgens</i>	Andersens horseshoe bat- A
16		<i>Rhinolophus yunanensis</i>	Dobson's horse shoe bat- A
17		<i>Rhinolophus sp</i>	Sp under id confirmation- A (Aul, 2002)
18		<i>Hipposideros ater</i> *	Dusky leaf-nosed bat- N
19		<i>Hipposideros cinereus</i>	Grey leaf-nosed bat- A
20		<i>Hipposideros diadema</i> *	Diadem leaf-nosed bat- N- LRnt
21		<i>Hippocideros fulvus</i>	Fulvous leaf nosed bat
22		<i>Hippocideros larvatus</i>	Horsefiled's roundleaf bat- A
23		<i>Hippocideros pomna</i>	Anderson's leaf nosed bat- A & N- LRnt
24	Vespertilionidae	<i>Hesperopternis tickelli</i>	Tickells bat- A
25		<i>Myotis horsfieldii</i> *	Horsefileds myotis bat- A & N- Dd
26		<i>Myotis sp</i>	Sp under id confirmation- A (Aul, 2002)
27		<i>Murina cyclotis</i>	N
28		<i>Miniopterus pusillus</i>	Nicobar long-fingered bat- N
29		<i>Pipistrellus javanicus</i>	Javan pipistrelle- A & N- LRnt
30		** <i>Pipistrellus coromandra</i>	Coramandel pipistrelle- N- Dd
31		<i>Pipistrellus camortae</i>	Kamortas pipistrelle- A
32		<i>Scatophilus kuhlii</i>	Asiatic lesser yellow bat- A & N
33		<i>Tylonycteris pachypus</i>	Bamboo bat- A
34		<i>Tapochozous melanopogon</i>	A & N- Dd
Carnivora			
35	Viverridae	<i>Paguma larvata</i>	Andamans palm civet- A
36		<i>Felis chaus</i>	Jugle cat- A- Introduced
37	Rodentia		
38	Sciuridae	<i>Funambulus pennantii</i>	Five striped palm squirrel- Introduced
39	Muridae	<i>Mus musculus</i>	House mouse
40		<i>Rattus stoicus</i>	Millers rat
41		<i>Rattus rattus</i>	Black rat
42		<i>Rattus muelleri</i>	Mullers rat
43		<i>Rattus rogersi</i>	Rogers rat
44		<i>Rattus tiomanicus</i>	Malayan wood rat
Insectivora			
45	Soricidae	<i>Crocidura andamanensis</i> *	Andamans ground shrew- A
46		<i>Crocidura hispida</i>	Thomas ground shrew- A
47		<i>Crocidura jenkinsi</i>	Jenkins ground shrew- A
48		<i>Crocidura nicobarica</i> *	Nicobar spiny Shrew- N- DD
49		<i>Tupaia nicobarica nicobarica</i>	Great Nicobar Island tree shrew- Sub sp.
50		<i>Tupaia nicobarica surda</i>	Little Nicobar Island tree shrew- Sub sp.
Artiodactyla			

51	Suidae	<i>Sus scrofa andamanensis</i>	Andaman wild boar-A- En
52		<i>Sus scrofa nicobarensis</i>	Nicobar wild boar- N- En
53	Elephantidae	<i>Elephas maximus</i>	Asian elephant- Introduced
	Pressiodactyla		
54	Cervidae	<i>Axis axis</i>	Spotted deer- Introduced
55		<i>Muntiacus muntjak</i>	Barking deer- Introduced
56		<i>Dugong dugon</i>	Dugong - CR(A 1a, 1c, 1d)

Source: Andrews & Sankaran, 2002; Aul, 2002; Aul & Vijayakumar, 2003; Bates, 1998; Das, 1998; Miller 1902. A – Andamans; N – Nicobars; * – Endemic; C – Critical; En – endangered; Vu – vulnerable; LRnt – lower risk near threatened; Dd – data deficient.

12. 9. Appendix 9: Some marine fishes around ANI coast

The interesting groups are, chimaerids (Chimaeridae), pelagic sharks (Carchaenidae), deep sea sharks (Squalidae), skates (Rhinobatidae) sting rays (Rajidae), herrings, Moray eels (Muraenidae) sardines (Clupeidae), anchovies (Clupeidae), milk fish, cat fish, (Ariidae), lizard fish (Synodontidae), flying fish (Exocoetidae), half beaks (Hemiramphidae), alligator gar (Belontiidae), soldier fish (Holocentridae), pipe fish (Syngnathidae), scorpion fish (Scorpaenidae), groupers (Serranidae), grunters (Teraponidae), flag tails (Kuhliidae), Bulls eye (Priacanthidae), cardinal fishes (Apogonidae), whittings (Sillaginidae), sucker fish (Echeneiidae), trevallys (Carangidae), silver belly (Leiognathidae), snappers (Lutjanidae), fusiliers (Caesionidae), silver biddys (Gerridae), grunters (Haemulidae), sweetlips (Haemulidae), breams (Sparidae), Lethrinidae), threadfins (Nemipteridae), jaw fish (Sciaenidae), goat fish (Mullidae), bat fish (Ephippidae), butterfly fish (Chaetodontidae), angel fish (Pomacanthidae), Talpapia (Cichlidae), demoiselles (Pomacentridae), anemone fish (Pomacentridae), mullets (Mugilidae), barracuda (Sphyraenidae), tassel fish (Polynemidae), wrasses (Labridae), parrot fish (Scaridae), blennids (Blennidae), dragonets (Callionymidae), gudgeons (Eleotrididae), goby (Gobiidae), sword fish (Istiophoridae), mackerel (Scombridae), tunas (Scombridae), flounders (Pleuronectidae), soles (Cynoglossidae), file fish (Balitidae), trigger fish (Balistidae), Box fish (Ostracidae), blow fish (Tetodontidae), and porcupine fishes (Diodontidae).

Source: Fisheries Department; CARU; Devi & Rao, 2003a; Devi & Rao, 2003b; Rajan, 2001; 2003; Rajan et al., 1993; Rao, 2004; Rao & Devi, 2004.

12. 10. Appendix 10: Corals around ANI

	Family	Species
1	Astrocoeniidae	<i>Stylocoeniella armata</i> Ehrenberg, 1834
2		<i>Stylocoeniella gnantheri</i> Bassen-Smith, 1890
3		Family Pocilloporidae
4		<i>Pocillopora damicornis</i> Linnaeus, 1758
5		<i>Pocillopora eydoni</i> Milne Edwards & Haime, 1860
6		<i>Pocillopora meandrina</i> Dana, 1846
7		<i>Podillopora verrucosa</i> Ellis & Solander, 1786
8		<i>Seriatopora candelabrum</i> Ehrenberg, 1834
9		<i>Seriatopora hystrix</i> Dana, 1846
10		<i>Stylophora pistillata</i>
11	Acroporidae	<i>Acropora aspera</i>
12		<i>Acropora</i> sp. I "brown digitate"
13		<i>Acropora austera</i> Dana, 1846
14		<i>Acropora brueggvmani</i> Brook, 1893
15		<i>Acropora cardinis</i> Dana, 1846

- 16 *Acropora cerealis* Dana, 1846
- 17 *Acropora chesterjieldensis*
- 18 *Acropora clathrata* Brook, 1891
- 19 *Acropora cophodactyla* Brook, 1842
- 20 *Acropora cytherea* Dana, 1846
- 21 *Acropora* sp. 1. "danai-like"
- 22 *Acropora digitifera* Dana, 1846
- 23 *Acropora divaricata* Dana, 1846
- 24 *Acropora echinata* Dana, 1846
- 25 *Acropora efflorescens*
- 26 *Acropora florida* Dana, 1846
- 27 *Acropora formosa* Dana, 1846
- 28 *Acropora gemmifera* Brook, 1892
- 29 *Acropora globiceps* Dana, 1846?
- 30 *Acropora grandis* Brook, 1892
- 31 *Acropora granulosa* Milne Edwards & Haime, 1860
- 32 *Acropora hemprichi?*
- 33 *Acropora humilis* Dana, 1846
- 34 *Acropora hyacinthus* Dana, 1846
- 35 *Acropora kosurini* Wallace
- 36 *Acropora loiseltae?* Wallace, 1994
- 37 *Acropora longicyathus* Milne Edward & Haime, 1860
- 38 *Acropora loripes* Brook, 1892
- 39 *Acropora lutkeni* Crossland, 1952?
- 40 *Acropora monticulosa* Bruggemann, 1879
- 41 *Acropora nasuta* Dana, 1846
- 42 *Acropora nobilis* Dana, 1846
- 43 *Acropora paliferci* Lamarck, 1816
- 44 *Acropora palmerae*
- 45 *Acropora paniculata* Verriti, 1902
- 46 *Acropora proximalis*
- 47 *Acropora pulchra* Brook, 1891
- 48 *Acropora robusta* Dana, 1846
- 49 *Acropora rudis*
- 50 *Acropora samoensis* Brook, 1891
- 51 *Acropora selago* Studer, 1878
- 52 *Acropora solitaryensis* Veron & Wallace, 1984
- 53 *Acropora spicifera* as in Wallace 1999
- 54 *Acropora spicifera* as in Wallace 1999
- 55 *Acropora tenuis* Dana, 1846
- 56 *Acropora valenciennesi* Milne Edwards & Haime, 1860
- 57 *Acropora vauhani* Wells, 1954
- 58 *Acropora gracilis* Bernard, 1896
- 59 *Acropora listeri* Bernard, 1896
- 60 *Astreopora myriophthalma* Lamarck, 1816
- 61 *Astreopora randlii* Lamberts, 1980
- 62 *Astreopora suggesta* Wells, 1954
- 63 *Montipora aequituberculata* Bernard, 1897
- 64 *Montipora caliculata* Dana, 1846
- 65 *Montipora capitata* Dana, 1846

66		<i>Montipora digitata</i>
67		<i>Montipora foveolata</i> Dana, 1846
68		<i>Montipora meandrina</i>
69		<i>Montipora tuberculosa</i> Lamarck, 1816
70		<i>Montipora turgescens</i>
71		<i>Montipora venosa</i> Ehrenberg, 1834
72		<i>Montipora verrucosa</i> Lamarck, 1816
73		<i>Montipora vietnamensis</i> Veron, 2000 or <i>M. porites</i> ?
74	Poritidae	<i>Porites annae</i> Crossland, 1952
75		<i>Porites cylindrica</i> Dana, 1846
76		<i>Porites evermanni</i> Vaughan, 1907
77		<i>Porites monticulosa</i> Dana, 1846
78		<i>Porites rus</i> Forskal, 1775
79		<i>Porites vaughani</i> Crossland, 1952
80	Siderasteridae	<i>Coscinaraea columna</i> Dana, 1846
81		<i>Coscinaraea crassa</i>
82		<i>Psammocora contigua</i> Esper, 1797
83		<i>Psammocora digitala</i> Milne Edwards, Haime, 1851
84		<i>Psammocora explanulata</i> van der Horst, 1922
85		<i>Psammocora haimeana</i> Milne Edwards & Haime, 1851
86		<i>Psammocora profundacella</i> Gardiner, 1898
87		<i>Psammocora superficialis</i> Gardiner, 1898
88		<i>Coelosera mayeri</i> Vaughan, 1918
89		<i>Gardineroseris planulata</i> Dana, 1846
90		<i>Leptoseris explanata</i> Yabe & Sugiyama, 1941
91		<i>Leptoseris harvatiensis</i> Vaughan, 1907
92		<i>Leptoseris incrustans</i>
93		<i>Leptoseris mycetoserioides</i> Wells, 1954
94		<i>Leptoseris scabra</i> Vaughan, 1907
95		<i>Leptoseris yabei</i> Pillai & Scherer, 1976
96		<i>Pachyseris gemmae</i> Nemenzo, 1955
97		<i>Pachyseris rugosa</i> Lamarck, 1801
98		<i>Pachyseris speciosa</i> Dana, 1846
99		<i>Pavona bipartita</i> Nemenzo, 1980
100		<i>Pavona cactus</i> Forskal, 1775
101		<i>Pavona clavus</i> Dana, 1846
102		<i>Pavona decussata</i> Dana, 1846
103		<i>Pavona duerdeni</i> Vaughan, 1907
104		<i>Pavona</i> sp. "duerdeni-like"
105		<i>Pavona explanulata</i> Lamarck, 1816
106		<i>Pavona maldivensis</i>
107		<i>Pavona varians</i> Verrill, 1864
108		<i>Pavona venosa</i> Ehrenberg, 1834
109	Fungiidae	<i>Ctenactis crassa</i> Dana, 1846
110		<i>Ctenactis echinata</i> Pallas, 1766
111		<i>Fungia concinna</i> Verrill, 1864
112		<i>Fungia fungites</i> Linnaeus, 1758
113		<i>Fungia granulosa</i> Klunzinger, 1879
114		<i>Fungia horrida</i> Dana, 1846
115		<i>Fungia klunzingeri</i> Doderlein, 1901

116		<i>Fungia moluccensis</i> Horst, 1919
117		<i>Fungia paumotensis</i> Stutchbury, 1833
118		<i>Fungia repanda</i> Dana, 1846
119		<i>Fungia scutaria</i> Lamarck, 1816
120		<i>Herpolitha limar</i> Houttuyn, 1722
121		<i>Lithophyllon manakensis</i> ? Veron, 2000
122		<i>Polyphyllia talpina</i> Lamarck, 1801
123		<i>Sandalolitha dentata</i> Quelch, 1884
124	Oculinidae	<i>Galaxea aerebia</i>
125		<i>Galaxea astreata</i> Lamarck, 1816
126		<i>Galaxea fascicularis</i> Linnaeus, 1767
127	Pectinidae	<i>Echinophyllia aspera</i> Ellis & Solander, -1788
128		<i>Echinophyllia echinata</i> Saville-Kent, 1871
129		<i>Echinophyllia echinaporoides</i> Veron & Pichon, 1979
130		<i>Myceditum elephantotus</i> Pallas, 1766
131		<i>Oxypora crassispinosa</i> Nemenzo, 1979
132		<i>Oxypora lacera</i> Verrill, 1864
133		<i>Pectinia alcorni</i>
134		<i>Pectinia pacoma</i> Dana, 1846
135	Mussidae	<i>Acanthastrea echinata</i> Dana, 1846
136		<i>Acanthastrea hemprichii</i> Ehrenberg, 1834
137		<i>Acanthastrea ishigakiensis</i> Veron, 1990
138		<i>Australomussa rowleyensis</i> Veron, 1985
139		<i>Cynarina lucrynalis</i> Milne Edwards & Haime, 1848
140		<i>Lobophyllia hemprichii</i> Ehrenberg, 1834
141		<i>Symphyllia agaricia</i> Milne Edwards & Haime, 1849
142		<i>Symphyllia radians</i> Milne Edwards & Haime, 1849
143		<i>Symphyllia recta</i> Dana, 1846
144	Merulinidae	<i>Hydnophora exesa</i> Pallas, 1766
145		<i>Hydnophora grandis</i> Gardiner, 1904
146		<i>Hydnophora microconos</i> Lamarck, 1816
147		<i>Hydnophora pilosa</i> Veron, 1985
148		<i>Hydnophora rigida</i> Dana, 1846
149		<i>Merulina ampliata</i> Ellis & Solander, 1786
150		<i>Merulina scabricula</i> Dana, 1846
151		<i>Scapophyllia cylindrica</i> Milne Edwards & Haime, 1848
152	Faviidae	<i>Diploastrea heliopora</i> Lamarck, 1816
153		<i>Echinopora gemmacea</i> Lamarck, 1816
154		<i>Echinopora hirsutissima</i> Milne Edwards & Haime, 1849
155		<i>Favia pallida</i> Dana, 1846
156		<i>Favia rotundata</i> Veron & Pichon, 1977
157		<i>Favia sicligera</i> Dana, 1846
158		<i>Favia truncatus</i> Veron, 2000
159		<i>Favites adha</i> Ellis & Solander, 1786
160		<i>Favites aculeicollis</i>
161		<i>Favites halicora</i> Ehrenberg, 1834
162		<i>Favites pentagona</i> Esper, 1794
163		<i>Goniastrea edwardsi</i> Chevalier, 1971
164		<i>Goniastrea minuta</i>
165		<i>Goniastrea pectinata</i> Ehrenberg, 1834

166		<i>Goniastrea reliformis</i> Lamarck, 1816
167		<i>Leptastrea purpurea</i> Dana, 1846
168		<i>Leptastrea transversa</i> Klunzinger, 1879
169		<i>Leptoria phrygia</i> Ellis & Solander
170		<i>Monastrea colemani</i>
171		<i>Monastrea curta</i> Dana, 1846
172		<i>Ondastrea crispata</i> Lamarck, 1816
173		<i>Oulophyllia laevis</i>
174		<i>Platygyra acuta</i> Veron, 2000
175		<i>Platygyra daedalea</i> Ellis & Solander, 1986
176		<i>Platygyra</i> sp. "green"
177		<i>Platygyra lamellina</i> Ehrenberg, 1834
178		<i>Plesiastrea versipora</i> Lamarck, 1816
179	Caryophylliidae	<i>Euphyllia ancora</i> Veroil & Pichon, 1979
180		<i>Euphyllia divisia</i> Veron & Pichon, 1979
181		<i>Euphyllia glubrescens</i> Clamisso & Fysenliardt, 1821
182		<i>Euphyllia yaeyamensis</i> Shirai, 1980
183		<i>Euphyllia lichentensleini</i> Milne Edwards & Haime, 1786
184		<i>Pterogyra sinuosa</i> Dana, 1846
185	Dendronhylliidae	<i>Tubastrae coccinea</i> Lesson, 1829
186		<i>Tubastrae diaphana</i>
187		<i>Tubastrae micranthus</i> Ehrenberg, 1834
188		<i>Turbinaria mesenterina</i> Lamarck, 1816
189		<i>Turbinaria stellulata</i> Lamarck, 1816
190	Heliporidae	<i>Heliophora</i> sp 1 "short"
191	Clavulariidae	<i>Tubipora musica</i> Linnaeus, 1758
192	Milleporidae	<i>Millepora dichotoma</i>
193		<i>Millepora exaesa</i>
194		<i>Millepora intricate</i>
195		<i>Millepora murrayensis</i>
196		<i>Millepora platyphylla</i>
197	Stylasteridae	<i>Stylaster</i> sp1 orange or pink
198		<i>Distichopora violacea</i> Ellis & Solander, 1788

Source: Pillai, 1972; 1983; Wafar, 1992; Qasim, 1998; Kulkarni, 2000; 2001; Vansden, 2001; Turner, et al, 2001.

12. 11. Appendix 11: Threatened species of shark, rays and molluscs

Shark and Ray		Schedule IV - Molluscs	
1	<i>Anoxypristis cuspidata</i>	1	<i>Cypraea lamaina</i>
2	<i>Carcharias hemiodon</i>	2	<i>Cypraea mappa</i>
3	<i>Glyphius gangeticus</i>	3	<i>Cypraea talpa</i>
4	<i>Glyphius glyphius</i>	4	<i>Fasciolaria trapazium</i>
5	<i>Himantura flutalis</i>	5	<i>Harpulina arausica</i>
6	<i>Pristis microdon</i>	6	<i>Lambis chirage</i>
7	<i>Pristis zijsron</i>	7	<i>Lambis chorogarrthica</i>
8	<i>Rhynchobatus djiddensis</i>	8	<i>Lambis crocea</i>
9	<i>Urogymnus asperimus</i>	9	<i>Lambis millipede</i>
Part IV-B - Molluscs		10	<i>Lambis scorpius</i>
1	<i>Cassia cornusa</i>	11	<i>Placenta placenta</i>

2	<i>Charoria iritonis</i>	12	<i>Strombus plicatus</i>
3	<i>Conus maineewardsi</i>	13	<i>Trochus niloticus</i>
4	<i>Cypraea casis rufa</i>	14	<i>Turbo marmoratus</i>
5	<i>Hippopus hippopus</i>		
6	<i>Nautilus pompilius</i>		
7	<i>Tridacna maxima</i>		
8	<i>Tridacna shumosa</i>		
9	<i>Tridictia spirallis</i>		

Source: Ministry of Environment and Forests, Gazette 2001.

12. 12. Appendix 12: Sea grass species and distribution in ANI

Family	Species	Distribution
1 Hydrocharitaceae	<i>Enhalus acoroides</i> (Linn. F) Royle	Camorta Island, North Reef Island, Little Nicobar, Pilomillow, Ponda west bay in Katchal, Bada Inaka, Pilo Bha in Great Nicobar
2	<i>Halophila ovalis</i> (R. Br.) Hook f	North Reef, Havelock, English, Henry Lawrence, Great Nicobar, Carmota, Nancowry and Katchal
3	<i>Halophila ovata</i> Gaud.	North Reef, Havelock, English, Henry Lawrence, Great Nicobar, Carmota, Nancowry, Katchal and Pilomillow
4	<i>Thalassia hemprichii</i> (Ehrenberg) Aschers	Kalipur, Pilomillow, Katchal, Havelock, Great Nicobar, Camorta, Chidiyatapu
5 Potamogetonaceae	<i>Cymodocea rotundata</i> (Ehrenb. & Hempr. Ex Aschers)	North Reef, Pilomillow, Great Nicobar west, Havelock, Katchal cast
6	<i>Cymodocea serrulata</i> (R. Brown) Ascherson & Magnus	Nancowry group of islands
7	<i>Syringodium isoetifolium</i> (Ascher) Dandy	English-Henry Lawrence island, Camorta, Nancowry, Katchal, Pilomillow, Little Nicobar
8	<i>Halodule pinifolia</i> (Miki) den Hartog	North Reef, Havelock, English, Henry Lawrence, Great Nicobar, Carmota, Nancowry, Katchal and Pilomillow
9	<i>Halodule uninervis</i> (Forskall) Ascherson	North Reef, Havelock, English, Henry Lawrence, Great Nicobar, Carmota, Nancowry, Katchal and Pilomillow

Source: Das, 1996.

12. 13. Appendix 13: Mangrove species present in ANI

Family	Species
1 Acanthaceae	<i>Acanthaceae ebracteatus</i>
2	<i>Acanthaceae illicifolius</i>
3 Myrsinaceae	<i>Aegicera corniculatum</i>
4 Avicenniaceae	<i>Avicennia marina</i>
5	<i>Avicennia officinalis</i>
6 Rhizophoraceae	<i>Bruguiera cylindrica</i>
7	<i>Bruguiera gymnorhiza</i>
8	<i>Bruguiera parviflora</i>
9	<i>Bruguiera sexangula</i>
10	<i>Ceriops tagal</i>

11	Euphorbiaceae	<i>Excoecaria agallocha</i>
12	Sterculiaceae	<i>Heritiera littoralis</i>
13	Combretaceae	<i>Lumnitzera littorea</i>
14		<i>Lumnitzera racemosa</i>
15	Arecaceae (Palmae)	<i>Nypa fruticans</i>
16		<i>Phoenix paludosa</i>
17	Rhizophoraceae	<i>Rhizophora apiculata</i>
18		<i>Rhizophora lamarckii</i>
19		<i>Rhizophora mucronata</i>
20		<i>Rhizophora stylosa</i>
21	Rubiaceae	<i>Scyphiphora hydrophyllacea</i>
22	Sonneratiaceae	<i>Sonneratia alba</i>
23		<i>Sonneratia apetala</i>
24	Meliaceae	<i>Xylocarpus granatum</i>
25		<i>Xylocarpus moluccensis</i>
26	Acanthaceae	<i>Acanthus volubilis</i>
27	Adiantaceae	<i>Acrostichum auerum</i>
28		<i>Acrostichum speciosum</i>
29	Asclepiadaceae	<i>Sarcolobus globosus</i>
30	Bignoniaceae	<i>Dolichandrone spathacea</i>
31	Fabaceae	<i>Derris trifoliata</i>
32	Meliaceae	<i>Aglaia cucullata</i>
33		<i>Xylocarpus gangeticus</i>
34		<i>Xylocarpus mekongensis</i>
35	Plumbaginaceae	<i>Aegialitis rotundifolia</i>
36	Rhizophoraceae	<i>Ceriops decandra</i>
37		<i>Kandelia candel</i>
38	Sonneratiaceae	<i>Sonneratia caseolaris</i>
39		<i>Sonneratia griffithii</i>
40	Tiliaceae	<i>Brownlowia teresa</i>
41	Apocynaceae	<i>Cerebra manghas</i>
42		<i>Cerebra odollum</i>
43	Asclepiadaceae	<i>Finlaysonia obovata</i>
44		<i>Tylophora tenuissima</i>
45	Asteraceae	<i>Pluchea indica</i>
46	Caesalpiniaceae	<i>Caesalpinia bonduc</i>
47		<i>Caesalpinia crista</i>
48	Cyperaceae	<i>Fimbristylis ferruginea</i>
49	Fabaceae	<i>Cynometra iripa</i>
50		<i>Cynometra ramiflora</i>
51		<i>Dalbergia candenatensis</i>
52	Flagellariaceae	<i>Flagellaria indica</i>
53	Hippocrateaceae	<i>Salacia chinensis</i>
54	Lecythidaceae	<i>Barringtonia racemosa</i>
55	Lythraceae	<i>Pemphis acidula</i>
56	Malvaceae	<i>Hibiscus tiliaceus</i>
57	Myrsinaceae	<i>Ardisia solanacea</i>
58	Pandanaceae	<i>Pandanus odoratissimus</i>
59	Verbenaceae	<i>Clerodendrum inerme</i>

Source: Debnath, 2004; Das, A K. 2001a; Mall et al., 1985; 1987.

12. 14. Appendix 14: Mangrove creeks and small rivers in ANI

NORTH ANDAMANS		
	Name	Location
1	Unnamed	North western side of Landfall Island
2	Unnamed	South western side of Landfall Island
3	Pine Bay Creek	North of North Andaman
4	Cape Hemingway Creeks (Two creeks)	North western
5	Kato Poiyo (Three creeks)	North western
6	Elizabeth Bay (Two creeks)	North western
7	Tikodung Creek	Western side
8	Duncan Bay (Two creeks)	Western side
9	Coldstream Bay (Three creeks)	Western side
10	Hudson Bay (Two creeks)	Western side
11	Beale Bay creek	Western side
12	Miapong Creek & one unnamed	Casuarina Bay creek, western side
13	Coffin Bay creek	western side - North Andaman
14	Pembroke creek	western side- North Andaman
15	McPherson Bay creek	western side - North Andaman
16	Hoare Bay creek	South western side- North Andaman
17	Gibb Creek	North eastern side- North Andaman
18	Palchar River & one unnamed creek	Cadelle Bay, North eastern side- North Andaman
19	Kalpong River	eastern side- North Andaman
20	Blair Bay creek	eastern side- North Andaman
21	Parangara Creek	South eastern - North Andaman
22	Kalara River (Kalighat Creek)	South of North Andaman
23	Khoda Khari creek	South of North Andaman
MIDDLE ANDAMANS		
24	Interview Island creeks (Three main creeks)	Eastern side Interview Island
25	Bajeta creek	North western- Middle Andaman
26	Tugapur creek	North- Middle Andaman
27	Webbi creek	North- Middle Andaman
28	Melegar Boilyn & Lungriwa creeks	Louis Inlet, western side, Middle Andaman
29	Robert Bay (Two creeks)	western side, Middle Andaman
30	Year- Tilal Jig	South west- Middle Andaman
31	Parlob Jig, Poti Jig, Bordin Jig & Yal Jig	South eastern- Middle Andaman
32	Rongat River (creek)	Eastern side- Middle Andaman
33	Betapur River	Cuthbert Bay, Eastern side- Middle Andaman
34	Karnatang Creek	North east- Middle Andaman
SOUTH ANDAMAN		
35	Needham Beach (two small creeks)	North western- South Andaman
36	Cape Bluff creek	West- South Andaman
37	Breakfast Bay creek	West
38	Port Campbell (Four creeks)	West
39	Cape Barwell creek	West
40	Bajalunta Jig	Constance Bay, north of bay
41	Tirur creek	Constance Bay, south of bay

42	Port Mouath (Two creeks)	South west- South Andaman
43	Corbyn's creek	South east- South Andaman
44	Mile Tilak creek	Shoal Bay- east South Andaman
45	Jirka Tang creek	Shoal Bay- east
46	Burataga Jig	Shoal Bay- east
47	Pochang	Shoal Bay- east South Andaman
48	Pottatang creek	North west- South Andaman
49	Lulu Jig	North of Baratang Island
50	Pawa jig	North of Baratang Island
51	Aug Jig	North east Baratang Island
52	Jarawa creek	South east Baratang Island
53	Rafter's creek	South Baratang Island

LITTLE ANDAMAN ISLAND

54	Bumila Creek	North- Little Andaman
55	Ekiti Bay creek	West - Little Andaman
56	Jackson Creek	West - Little Andaman
57	Tochangeou creek	West - Little Andaman
58	Endeageteoa	West - Little Andaman
59	Kwechenuan	South Bay- south Little Andaman
60	Chananeu	South Bay
61	Kojilac	South Bay
62	Ingoie	South Bay
63	Toibalewe	South Bay
64	Tae-Eya creek	North east- Little Andaman
65	Dugong Creek	North east
66	Butler Bay (Two creeks)	South east
67	Hut Bay (Two creeks)	South east

GREAT NICOBAR ISLAND

68	Ganges River	North- Great Nicobar Island
69	Dagmar River	Casuarina Bay-West- Great Nicobar Island
70	Alexandra River	West- Great Nicobar Island
71	Pulo Bha creek	South west- Great Nicobar Island
72	Galathea River	South Bay- South east Great Nicobar Island
73	Five unnamed creeks	Eastern side (Between 35 km and Campbell Bay)
74	Lalul Anch creek	North east - Great Nicobar Island

Source: Andrews & Tripathy, 2004.

12. 15. Appendix 15: Medicinal plants of ANI and ethnobotanical information

	Name of the Plant	Local Name (Used by)
1	<i>Abrus precatorius</i> L.	Kaheich/Pon-yamoh (N)Tanuve (O)
2	<i>Abutilon indicum</i> L.	Kanko Tih/Molvearu/Malvari (N)
3	<i>Acalypha indica</i> L.	Lankop/Kulching/Tamkarope (N)
4	<i>Acanthus ilicifolius</i> L.	
5	<i>Achyranthes aspera</i> L.	Chirchiri
6	<i>Achyranthes bidentata</i> Bl.	Panuko (N)

7	<i>Acrostichum aureum</i> L.	Paku Laut (N)
8	<i>Actopanax canniiformis</i> (Forst.) K. Schum.	
9	<i>Adenia nicobarica</i>	
10	<i>Adenia penangiana</i> (Don) de Wilde	Tinchan (N)
11	<i>Adenostemma lavenia</i> L. Kunt.	Mi-Top (N)
12	<i>Aegle marmelos</i> Corr	Bilva
13	<i>Aerva lanata</i> Juss.	Karna-ha-la (N)
14	<i>Afzelia bijuga</i> A. Gray.	
15	<i>Ageratum conyzoides</i> L.	So-pak-re (N)/Thamfaihu(N)
16	<i>Aglanema sinalex</i> Bl.	Pumoh (N)
17	<i>Aglaiia argentea</i> Bl.	
18	<i>Alchornea javensis</i> Muell-Arg.	Miltich (N)
19	<i>Alchornea rugosa</i> (Lour.) Muell Arg. L.	Kalifato
20	<i>Alpinia</i> sp.	
21	<i>Alstonia kurzii</i> Ilk. f.	
22	<i>Alstonia macrophylla</i> G. Don.	Chuharoi/Tachuroi (N)
23	<i>Amaranthus spinosus</i> L.	
24	<i>Amiscolotype mollissima</i> Massk.	Piruh (N)
25	<i>Amomum fenzlilii</i> (Kurz.) Schum.	
26	<i>Amomum aculeatum</i>	Jungli haldi (J)
27	<i>Ampelocissus barbata</i> (Wall) Planch.	
28	<i>Anacardium occidentale</i> L.	
29	<i>Ancistrocladus tectorius</i> (Lour.) Merr.	
30	<i>Ancistrocladus extensus</i> Wall.	
31	<i>Annona reticulata</i> L.	
32	<i>Annona</i>	(J)
33	<i>Annona squamosa</i> L.	Eang Alo
34	<i>Anthocephalus chinensis</i> Rich ex. Walp.	
35	<i>Apama tomentosa</i> (Bl.) Engl.	
36	<i>Aphanamixis polystachya</i> (Wall) Parker	
37	<i>Aporosa villosula</i> Kurz.	
38	<i>Ardista oxyphylla</i> wall.	
39	<i>Ardisia solanacea</i> Roxb.	Chakafum/Minkuon (N)
40	<i>Areca catechu</i> Linn	Kahkoh
41	<i>Areca triandra</i> Linn.	Kahkoh
42	<i>Argyrea hookeri</i>	
43	<i>Aristolochia tagala</i> Cham.	Lakiom/Minchokoyen/Punkot (N)
44	<i>Artabotrys speciosus</i>	
45	<i>Artocarpus lacucha</i> Buch. Ham.	
46	<i>Artocarpus chaplasha</i>	(J)
47	<i>Averrhoa bilimbi</i> L.	Tok (N)
48	<i>Avicennia marina</i> Vierh.	
49	<i>Baccaurea sumatrana</i> (Miq) Muell-Arg.	Kachchmai (N)

50	<i>Baccaurea sapida</i>	Khatta phal (J)
51	<i>Bacopa monieri</i> (L.) Penn.	
52	<i>Barleria prionitis</i> L.	
53	<i>Barringtonia asiatica</i> (L.) Kurz.	Cingola (O) Av-an/Kinyav (N)
54	<i>Barringtonia racemosa</i> (L.) Roxb.	Leun
55	<i>Bixaorellana</i> L.	Akvel (N)
56	<i>Blumea balsamifera</i> (L.) DC.	Hotik (N)
57	<i>Blumea virens</i> DC.	
58	<i>Boerhavia diffusa</i> (L.)	
59	<i>Breynia retusa</i> (Dens) Alston.	Fanot/Piteong (N)
60	<i>Bridelia tomentosa</i> Bl.	Ranam/Ka-noh (N)
61	<i>Bruguiera gymnorhiza</i> (L.) Lamk.	Tofooto (N)
62	<i>Caesalpinia bonduc</i> (L.) Roxb.	Kalcin (A), Vaknuato (N)
63	<i>Cajanus cajan</i> (L.) Mill	Huklik (N)
64	<i>Calamosagus lacinosus</i>	
65	<i>Callicarpa inerme</i> (L.) Gaertn	Ma-nyya (N)
66	<i>Callicarpa longifolia</i> Lamk.	Kin-Vi-Ti (N)
67	<i>Callophyllum innophyllum</i> L.	In-Yanng, La Monk
68	<i>Callophyllum spectabile</i> Willd.	
69	<i>Calotropis gigantea</i> (L.) R.Br.	Gilerset, Akwan
70	<i>Canarium euphyllum</i> Kurz	
71	<i>Canavalia cathartica</i> Thou.	Minuchi (N)
72	<i>Cardiocarpus andamanicus</i> (Kurz) Howard	Kamarang (N)
73	<i>Cardiospermum helicacabum</i>	
74	<i>Caryota mitis</i>	Mari pathi (J)
75	<i>Casearia grewiaefolia</i> Vent. var. <i>deglabrata</i> Koord.	Kill-toung (N)
76	<i>Cassia alata</i> L.	Palal (A), Thinbaw (N)
77	<i>Cassia occidentalis</i> L.	Marohah (N)
78	<i>Cassia tora</i> L.	Milum-auh (N)
79	<i>Cassytha filiformis</i> L.	Aakashavalli (S)
80	<i>Catharanthus roseus</i> (L.) Schott	
81	<i>Cayratia japonica</i> (Thumb.) Gagnp	Kithot (N)
82	<i>Celosia argentea</i> L.	Motiyn
83	<i>Cerlops tagal</i> Roxb	
84	<i>Centothea lappacea</i> (L.) Desv.	Kunholi (N)
85	<i>Chromolaena odorata</i> (L.) King & Robinson	Katih/Euhbens (N) Hawa-booti
86	<i>Chydenanthus excelsus</i> (Bl.) Miers	
87	<i>Cissus aristata</i> (Bl.)	
88	<i>C.repens</i> Lamk	
89	<i>Citrus maxima</i> Merr.	
90	<i>Claoxylon polot</i> (Burm.f) Merr.	Sing-Ke-Ra (N) Hanngonyo
91	<i>Cleidion nitidum</i> Thw.	Tam-fa-tu(N)
92	<i>Clenogyne grandis</i> Benth	

93	<i>Clerodendrum paniculatum</i>	Kalanuovo/Tangnorg/yamon (N)
94	<i>C. viscosum</i> Vent.	Manjayay (N)
95	<i>Cocos nucifera</i> L.	
96	<i>Codiocarpus andamanicus</i> (Kurz) Howard	Kamarang
97	<i>Coldenia procumbens</i> L.	
98	<i>Colocasia antiquorum</i> Schott	Aluka (S)
99	<i>Colubrina asiatica</i> (L.) Brongn	Inamai (N)
100	<i>Corchorus aestuans</i> L.	
101	<i>Cordia grandis</i> Roxb	
102	<i>Cordia dichotoma</i> Forst. f.	Minyap(N)
103	<i>Cordia obliqua</i> Willd	Matka (N)
104	<i>Combretum laefolium</i> Bl.	
105	<i>Costus speciosus</i> (Koen) Sm.	
106	<i>Crataeva religiosa</i> Forst. f.	Varuna (S)
107	<i>Croton argyratus</i> Bl.	Minthunah (N)
108	<i>Cryptolepis buchanani</i> R. & S.	
109	<i>Cucurbita</i>	(J)
110	<i>Curcuma zedaria</i>	Jungli haldi (J)
111	<i>Curculigo orchoides</i> Gaertn.	
112	<i>Cupania jackiana</i> Hiern.	Lamang (N)
113	<i>Cycas rumphii</i> Miq	Triella/Tivan (N)
114	<i>Cyathea albo-setacea</i> (Bedd.) Copel	
115	<i>Cyathea sphimulosa</i> Hook	
116	<i>Cyclea peltata</i> (Lam) Diels	Chane Un (N)
117	<i>Cycas rumphii</i>	Arguna (J)
118	<i>Cynometra ramiflora</i> L. ssp. Bijuga	Mink (A)
119	<i>Cynodon dactylon</i> (L.) Pers.	Dub
120	<i>Cyperus javanicus</i> Houtt.	Tokut (N)
121	<i>Cyperus kyllinga</i> Endl.	Viyo/Nirbisi
122	<i>Daphne papyracea</i> Wall. Ex Steud	
123	<i>Datura metel</i> L.	Tukul/Katakal(N)
124	<i>Dendrobium crumentum</i> Swartz.	
125	<i>Dendrobium secundum</i> Wall.	
126	<i>Derris indica</i> Benn.	Biochunc-aichukabe (O) Karanj
127	<i>Derris sinuate</i> Benth. ex Thw	
128	<i>Desmodium heterocarpon</i> DC.	Mei (N)
129	<i>D. umbellatum</i> (L) DC.	Damle(O)
130	<i>Dioscorea bulbifera</i> L.	
131	<i>Dioscorea glabra</i>	
132	<i>Dioscorea pentaphylla</i> L.	
133	<i>Diospyros andamansium</i>	Kundu (J)
134	<i>Diospyros montana</i> Roxb	Tumala (S)
135	<i>Diospyros uandulata</i> Wall. ex G. Don	Lintoh

136	<i>Dischidia benghalensis</i> Coleb.	Talima (N)
137	<i>Dischidia major</i> (Vahl) Mierr.	
138	<i>Donax cannaeformis</i> (Forst.) Schum.	Kagle/Tombowka(O)/Amok (N)
139	<i>Dracaena angustifolia</i> (Medic.) Roxb.	
140	<i>Dracontomehan</i>	Khatta (J)
141	<i>Dregia volubilis</i> (L.) Ilk f.	
142	<i>Drynaria diereifolia</i> (L.) Sm.	
143	<i>Drypetes assamica</i> .Hk. f.	Torulelu (O)
144	<i>Dysoxylum thyrsoideum</i> Griff. var <i>andamanica</i> (King.)	
145	<i>Eclipta alba</i>	
146	<i>Eclipta proserata</i> (L.)	
147	<i>Ehretia laevis</i> Roxb.	
148	<i>Elaeocarpus serratus</i> L.	
149	<i>Elaeocarpus sphaericus</i> (Gaertn)	Rudraksha (S)
150	<i>Elatostemma sesquifolium</i> Hassk.	
151	<i>Elagnus latifolia</i> L.	Tapot
152	<i>Elephantopus scaber</i> L.	
153	<i>Eleutheranthera radalis</i> (Sw.) Schult-Bip	Hinyoon
154	<i>Entada pursaetha</i> DC.	
155	<i>Eria bractescens</i> Lindl. var. <i>affinis</i> (Griff) Hk. f.	
156	<i>Erioglossum rubiginosum</i> (Roxb) Bl.	Ahe (N)
157	<i>Erycibe articulata</i> Roxb.	
158	<i>Erythrina variegata</i> L. var. <i>orientalis</i> (L.) Merr	Mokek
159	<i>Eulophia andamensis</i> Reichb. f.	
160	<i>Euonymus javanicus</i> Bl.	Ravong
161	<i>Eupatorium odoratum</i> L.	
162	<i>Euphorbia atoto</i> Forst. f.	Mu-pet
163	<i>Euphorbia chamasyce</i> L.	Dudhia
164	<i>Euphorbia hirta</i> L.	Dudhi
165	<i>Euphorbia longan</i>	
166	<i>Excoecaria agallocha</i> L.	
167	<i>Ficus ampelas</i>	
168	<i>Ficus hispida</i> Linn.	Kakodumbare,Gular (J)
169	<i>Ficus religiosa</i> L.	Pipal
170	<i>Fibracurea chloroleuca</i> Miers.	
171	<i>Flagellaria indica</i> L.	
172	<i>Fragraea racemosa</i> Jack ex. Wall	Rohekui
173	<i>Ganophyllum falcatum</i> BL.	
174	<i>Garcinia nervosa</i> . Miq.	
175	<i>Garcinia cowa</i>	J/Khatta (J)
176	<i>Garcinia microstigma</i>	J/Khatta (J)
177	<i>Garuga pinnata</i> Roxb.	
178	<i>Grevia acuminata</i> A. L. Juss.	

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|-----|---|----------------------------|
| 179 | <i>Globba marantia</i> L. | |
| 180 | <i>Glöchidion calocarpum</i> Kurz. | Lukiana/Angchonsi |
| 181 | <i>Glycosmis arborea</i> (Roxb) DC. | |
| 182 | <i>G. pentaphylla</i> (Retz) Corr. | Shakota (S) |
| 183 | <i>Gnetum gnemon</i> L. | Amih/Hituh (N) |
| 184 | <i>Gossypium herbaceum</i> L. | Ruhikanhi (N) |
| 185 | <i>Guettarda speciosa</i> L. | |
| 186 | <i>Hedyotis biflora</i> (L) Lamk. | |
| 187 | <i>Hedyotis paradoxa</i> kurz | Infich |
| 188 | <i>H. vestita</i> G. Don | |
| 189 | <i>Helicteres angustifolia</i> var. <i>obtus</i> King | |
| 190 | <i>Heritiera littoralis</i> Dryand. | |
| 191 | <i>Hernandia peltata</i> Meissn. | |
| 192 | <i>Hetaeria oblique</i> Bl. | |
| 193 | <i>Heteropogon contortus</i> Beauv. | |
| 194 | <i>Hibiscus tillaceus</i> L. | Ta-u-Ku (N) Bala bheda (S) |
| 195 | <i>Hiptage benghalensis</i> (L) Kurz | |
| 196 | <i>Homolomena aromatica</i> | Laman |
| 197 | <i>Homonia riparia</i> Lour. | |
| 198 | <i>Horsfieldia glabra</i> Bl. Warb. | (J) |
| 199 | <i>Hoya parasitica</i> Wall. | Lanvoh |
| 200 | <i>Hyptis capitata</i> Jacq. | Kumtop (N) Basram-ghas |
| 201 | <i>Hyptis suaveolens</i> S.(L) Poit | |
| 202 | <i>Imperata cylindrica</i> L. | |
| 203 | <i>Ipomoea campanulata</i> L. | Lumtok |
| 204 | <i>Ipomoea gracilis</i> R. Br. | Panarecha |
| 205 | <i>Ipomea pes-caprae</i> (L) Sweet. ssp.
<i>brasiliensis</i> (L) Oost. | |
| 206 | <i>Ixora brunnescens</i> Kurz. | Hamaok |
| 207 | <i>Ixora grandiflora</i> Zoll. & Mor. | |
| 208 | <i>Jasminum acuminatissimum</i> Bl. | |
| 209 | <i>Jasminum multiflorum</i> Andr.
Var. <i>nicobaricum</i> Thoth. | Moptupo (N) |
| 210 | <i>Jasminum rutchiei</i> Cl. Var. <i>purpurascens</i> Cl. | Madayanti (S) |
| 211 | <i>Jatropha curcas</i> L. | Boi-Pong |
| 212 | <i>Jatropha gossypifolia</i> L. | |
| 213 | <i>Knema andamanica</i> | (J) |
| 214 | <i>Kunsleria</i> | (J) |
| 215 | <i>Lannea coromandelica</i> (Houtt) Merr. | Kanrel (N) |
| 216 | <i>Lantana camara</i> L. var. <i>aculeata</i> (L) Mold. | |
| 217 | <i>Lasianthus andamanicus</i> Hk. f. | |
| 218 | <i>Lasianthus cyanocarpus</i> Jack | Loi |
| 219 | <i>Laumea sermentosa</i> (Wild) O.Ktzc. | |
| 220 | <i>Leea aequata</i> L. | |
| 221 | <i>Leea angulata</i> Miq | Hasti Kama |

222	<i>Leea grandifolia</i>	Takleyu
223	<i>Leea indica</i> (Buam. f.) Merr.	Khujaliwali, Atokona
224	<i>Lepidopetalum jackiarum</i> Radik.	
225	<i>Lepisanthes andamanica</i> King	
226	<i>Leuata spinosa</i> Warmb.	
227	<i>Litsea glutinosa</i> (Lour.) C.B. Robins.	
228	<i>L. Kurzii</i> (King)	
229	<i>Loranthus longiflorus</i> Desv.	
230	<i>Lygodium flexuosum</i> (L.) Sw.	
231	<i>Macaranga indica</i> Wt.	Kanhed/kinrul (N)
232	<i>Macaranga tanarius</i> (L.) Muelc. Arg.	
233	<i>Macaranga triloba</i> (Bl.) Muell. Arg.	
234	<i>Maesa andamanica</i> Kurz	
235	<i>Maesa ramentacea</i> (Roxb.) DC.	Hing- Kwai
236	<i>Mallotus andamanicus</i> Hk. f.	
237	<i>Mallotus oblongifolius</i> Muell. Arg.	
238	<i>Mallotus peltatus</i> (Geis.) Muell. Arg.	Kalokvak (N) Patage/Obbott-ache (O)
239	<i>Mangifera andamanica</i> King	Jangli Aam
240	<i>Mangifera indica</i>	Aam
241	<i>Manilkara achras</i> (Mill.) Fosberg.	
242	<i>Manilkara littoralis</i> (Kurz) Dub	Lamkiny
243	<i>Masserschimidia argentea</i> (L.f.) Jolvist.	Kafap
244	<i>Melastoma affinis</i> D. Don	
245	<i>M. malabathricum</i> L.	Kinah
246	<i>Melanthesa rhamnoides</i> (Retz) Bl.	
247	<i>Melochia umbellata</i> (Houtt.) Stapf.	To Hu O ko (N)
248	<i>Memecylon caeruleum</i> Jack.	
249	<i>Merremia peltata</i> (L.) Merr.	Parasrani (S)
250	<i>Merremia umbellata</i> (L.) Hallier f. <i>ssp. umbellata</i>	
251	<i>Mesua ferrea</i> L.	
252	<i>Micromelum integerrimum</i> (Roxb.) Wt. & Arn. ex. Roem.	
253	<i>Mischocarpus sundaticus</i> Bl.	
254	<i>Mitragyna rotundifolia</i> (Roxb.) Kunze	Kasmi
255	<i>Mitrephora praini</i>	(J)
256	<i>Modecca cardiophylla</i> Mart.	
257	<i>Morinda citrifolia</i> L.	Lam-onk, Lu-rong, (N)
258	<i>Morinda tinctoria</i> L.	
259	<i>Moringa oleifera</i> Lamk.	Sahjan
260	<i>Morus alba</i> L.	Sahtoot
261	<i>Mucuna gigantea</i> (Willd.) DC.	Teetockala (O)
262	<i>Murraya koenigii</i> (L.) Spreng.	Tayam
263	<i>Mussaenda frondosa</i> L.	Srivati (S)
264	<i>Mussaenda macrophylla</i> Wall.	

265	<i>Musa sapientium</i>	J/Khatta (J)
266	<i>Myristica andamanica</i> Hoff.	Kinkoma (N)Bara Jarphal/Jarphal (J)
267	<i>Myristica elliptica</i> Wall	
268	<i>Neisosperma oppositifolium</i> (Lam) Fosb. & Sac	
269	<i>Neodissochaeta celibica</i> Bl. Bakh. f	
270	<i>Nicotiana tabacum</i> L.	
271	<i>Nipa fruticans</i>	Dhani patti (J, N, O, S)
272	<i>Nyctanthes arbor-tristis</i> L.	Parijat,Shri Singhar
273	<i>Ochrasia oppositifolia</i> (Juss.) Moldenke	
274	<i>Ocimum sanctum</i> L.	
275	<i>Ophiorrhiza mungas</i> L.	Sarpakshi (S)
276	<i>Ophiorrhiza nicobarica</i> Balakr.	
277	<i>Orophaea kutschallica</i> Kurz.	Tunyoge(O)
278	<i>Paederia scandens</i> (Lour.) Merr.	
279	<i>Paederia foetida</i> L.	Prasarini (S)
280	<i>Pandanus andamanensis</i>	Kcora (J)
281	<i>Pangium edule</i>	
282	<i>Papilionanthe teres</i> (Roxb.) Schltr.	
283	<i>Parabacna sagittata</i> Miers. Ex. Hook. F. & Thomson	
284	<i>Parameria laevigata</i> (Guss.) Moldenke	
285	<i>Parasonia laevigata</i> (Moon) Alst.	
286	<i>Passiflora foetida</i> L.	Kin-vaal
287	<i>Passiflora suberosa</i> L.	
288	<i>Pavetta indica</i> L. var. <i>tomentosa</i> Roxb.	
289	<i>Pedilanthus tithymaloides</i>	
290	<i>Pellionia proceridifolia</i> Kurz	
291	<i>Pemphis acidula</i> J.R. & G. Forst.	Puheal - ol (N)
292	<i>Peperomia pellucida</i> (L.) H. B.K.	Vol-tok
293	<i>Pericampylus glaucus</i> (Lam.) Merr.	
294	<i>Peristrophe montana</i> Nees.	
295	<i>Petunga microcarpa</i> (Bl.) DC	
296	<i>Phyla nodiflora</i> (L.) Greene	Jalapippali (S)
297	<i>Phyllanthus amarus</i> Schum & Tchem.	Topiloi Rai, Pubealol (N)
298	<i>Phyllanthus urinaria</i> L.	
299	<i>Phyllanthus emblica</i>	Kupu-utoh
300	<i>Phyllanthus gomphocarpus</i> Hook. f.	Fantront
301	<i>Phyllanthus reticulatus</i> Poir	Bhui awla
302	<i>Phyllanthus virgatus</i> Forst. f.	
303	<i>Phymatodes scolopendria</i> (Brum.) Ching.	
304	<i>Physalis minima</i> L.	Kalaheui/Tatroh (N)
305	<i>Physalis angulata</i> L.	
306	<i>Pinagan costata</i>	Khumba (J)
307	<i>Piper betel</i> L.	Humo, Tamboola

308	<i>Pipturus argenteus</i> (Forst.f.) wedd.	Paukam
309	<i>Pisomea aculeate</i> L.	
310	<i>Pisomea umbellofera</i> (Forst) seen	
311	<i>Pithecellobium angulatum</i> Benth.	
312	<i>Pithecellobium ellipticum</i> (BL.) Hassk	
313	<i>Planchonella obovata</i> (R. Br.) Pierre	Rok Toh
314	<i>Polyalthia jenkinsii</i> Hk. f. & Th.	Topilek
315	<i>Polyalthia parkinsonii</i>	(J)
316	<i>Pometia pinnata</i> Forst. and Forst. f.	Thit Kandu (J)
317	<i>Pothos scandens</i> L.	Tomap
318	<i>Premna corymbosa</i> (Burm. f.) Rottl & Willd.	Agnimantha (S)
319	<i>Premna obtusifolia</i>	Monkun
320	<i>Premna serratifolia</i> L.	Touonja(O)
321	<i>Prunus martabanica</i>	Lal thingham (J)
322	<i>Pseudoranthura album</i> (Roxb.) Merr.	Hinkok
323	<i>Psychotria andamanica</i> Kurz.	
324	<i>Psychotria malayana</i> Jack.	
325	<i>Psychotria polyneura</i> Kurz var. <i>longipetala</i> King.	
326	<i>Psychotria platyneura</i> Kurz	
327	<i>Psychotria sorientosa</i> Bl.	
328	<i>Punica granatum</i> L.	
329	<i>Randia densiflora</i> Benth	Madama Bheda (S)
330	<i>R.forbesii</i> King. & Gamb.	
331	<i>Raphidophora lancifolia</i> Schott.	
332	<i>Rauvolfia reflexa</i> T. & B.	
333	<i>Rhizophora mucronata</i> L.	
334	<i>Rhizophora paniculata</i> Bl.	Turu
335	<i>Ricinus communis</i> L.	Maah, Reri
336	<i>Rubus moluccanus</i> L.	Vokunto
337	<i>Saccharum spontaneum</i> L.	
338	<i>Salacia chinensis</i> L.	Saptarangi (S)
339	<i>Samanea saman</i> (Jacq.) Merr.	
340	<i>Sandoricum indicum</i> Cav.	
341	<i>Sansevieria trifasciata</i>	
342	<i>Saprosma consimile</i> Kurz.	
343	<i>Sarcolobus globosus</i> Wall	Fonghanch
344	<i>Sarcostigma wallichii</i> Baill.	
345	<i>Saregada multiflorum</i> Baill.	
346	<i>Saurauia bracteosa</i> DC.	
347	<i>Scuevola koenigii</i>	
348	<i>Scaevola serioea</i> Vahl.	Kwyac/Tuful (N)
349	<i>Scaevola taccada</i> (Gaertn.) Roxb.	Tochonk
350	<i>Schefflera yamaloa</i> (Wt. & Arn)	

- | | | |
|-----|---|---|
| 351 | <i>Scindapsis officinalis</i> (Roxb.) Schott. | Gaja pippali (S) |
| 352 | <i>Scoparia dulcis</i> L. | |
| 353 | <i>Semecarpus kurzii</i> Engl. | |
| 354 | <i>Sida acuta</i> Burm. f. | Sila - hak, Chohi, Bala bheda (S) |
| 355 | <i>Sida rhombifolia</i> L. | Bariara |
| 356 | <i>Solanum nigrum</i> L. | |
| 357 | <i>Solanum torvum</i> Sw. | Katahne (S) |
| 358 | <i>Sophora tomentosa</i> L. | Pantangkul |
| 359 | <i>Spathoglottis plicata</i> Bl. | |
| 360 | <i>Spilanthes calba</i> DC. | Aakarakarabha (S) |
| 361 | <i>S. paniculata</i> DC. | |
| 362 | <i>Spondias pinnata</i> L. | Amratika (S) |
| 363 | <i>Sphenodesme involucre</i> (Presl.) Robin | |
| 364 | <i>Sphyranthra lutescens</i> (Kurz.) Pax. & Hoff. | Nyaiya |
| 365 | <i>Stenochlaena palustris</i> (Burm.) Bedd. | |
| 366 | <i>Sterculia parviflora</i> Roxb. | |
| 367 | <i>S. rubiginosa</i> Vent. | Fuk |
| 368 | <i>S. villosa</i> Roxb. | |
| 369 | <i>Streblus aspera</i> Lour. | |
| 370 | <i>Stemonurus secundiflorus</i> Bl. | |
| 371 | <i>Suregada multiflora</i> (Juss.) Bail | Mongeng |
| 372 | <i>Symplocos racemosa</i> Roxb. | |
| 373 | <i>Syzigium cumini</i> (L.) Skeels. | J/Jammun (J) |
| 374 | <i>S. samarangense</i> (Bl.) Merr. & Perry | Ipoh |
| 375 | <i>Tabernaemontana crispa</i> Roxb. | Thikarothung (N). Kalitngench (N) Koraiya (S) |
| 376 | <i>Tacca leontopetaloides</i> (L.) Ktze. | |
| 377 | <i>Tamarindus indica</i> L. | Chaf |
| 378 | <i>Tarenna weberaefolia</i> Kurz. Balakr. | |
| 379 | <i>Terminalia catappa</i> L. | Chap (A) Tohangko. Gruhadnuna (S) |
| 380 | <i>Thespesia populnea</i> Corr. | Tebokala (O) |
| 381 | <i>Thottea tomentosa</i> | (J) |
| 382 | <i>Tournefortia argentea</i> L. f. | |
| 383 | <i>Tremma tomentosa</i> (Roxb.) Hara. | |
| 384 | <i>Trichosanthes bracteata</i> (Lam.) Voigt. | |
| 385 | <i>Trichosapthes tricuspidata</i> | (J) |
| 386 | <i>Trichosapthes palmata</i> Roxb. | Vishala (S) |
| 387 | <i>Tridax procubens</i> L. | Atkat |
| 388 | <i>Trigonostemon longifolius</i> | Gu gma |
| 389 | <i>Triumfetta rhomboidea</i> Jacq. | Kasin-rioch |
| 390 | <i>Tylophora indica</i> (Burm.f.) Merr. | Anantannula (S) Tolyama |
| 391 | <i>T. tenuis</i> Bl. | |
| 392 | <i>Uncaria ferrea</i> (Bl.) DC. | |
| 393 | <i>Uraria lagopodioides</i> L. Desv. | Prishniparni (S) |

394	<i>Urena lobata</i> L.	Katschinin (A), Kasinrah (N) Ghurampali (S)
395	<i>Vernonia chinensis</i> Less.	
396	<i>V. cinerea</i> (L.) Less.	Hopal, Kujlin
397	<i>Vigna marina</i> (Burm.f.) Merr.	Hinriyan
398	<i>Vitex negundo</i> L.	Nirgundi (S)
399	<i>Vitex trifolia</i> L. f.	
400	<i>Wattakaka volubilis</i> (L. f.) Stapf.	Madhumalathi (S), Pakon
401	<i>Wedelia biflora</i> (L.) DC.	Kotan (N), Bringaraj (S), Takunkala (O)
402	<i>Ximenia americana</i> Willd.	Chandana (S)
403	<i>Zanthoxylum ovalifolium</i> Wt.	Tumburu (S)
404	<i>Zingiber officinale</i> L.	
405	<i>Zingiber squarrosum</i>	
406	<i>Zingiber zerumbet</i> Sm.	

Source: NBRI, (2003). N – Nicobari; S – Shompen; A – Andamanese; J – Jarwa.

12. 16. Appendix 16: Plants used by the Chota Nagpur Community in ANI

	Plant species	Plant family	Local name	General use
1	<i>Adenanthera pavonina</i>	Mimosaceae	Yewgi	Timber; firewood; rice wine
2	<i>Aglia andamanica</i>	Meliaceae	Latou	Construction
3	<i>Albizia chinensis</i>	Mimosaceae	Bonmeza	Timber; rice wine
4	<i>Albizia procera</i>	Mimosaceae	Coco	Rice wine
5	<i>Amoora wallichii</i>	Meliaceae	Lalchini	Timber
6	<i>Amorphophallus campanulatus</i>	Araceae		edible
7	<i>Areca triandra</i>	Arecaceae	Jungli supari	Construction
8	<i>Artabotrys speciosus</i>	Annonaceae		Medicinal
9	<i>Artocarpus lakoocha</i>	Moraceae	Iakuch	Construction
10	<i>Bombax insigne</i>	Bombacaceae	Didu	Timber; medicinal
11	<i>Bouea oppositifolia</i>	Anacardiaceae	Mariam	Firewood; wild edible
12	<i>Calamus longisetus</i>	Arecaceae	Jungli beth	Construction
13	<i>Calamus pseudo-rivialis</i>	Arecaceae	Sangabeth	Agri. implements; thirst quencher
14	<i>Canarium euphyllum</i>	Burseraceae	Dhup	Trapping birds
15	<i>Caryota mitis</i>	Arecaceae	Madi pathi	edible
16	<i>Cinnamomum verum</i>	Lauraceae	Jungli tejpatha	Culinary ingredient
17	<i>Cleistanthus myrianthus</i>	Euphorbiaceae	Gorai	Fish stupefier; rice wine
18	<i>Dinochloa andamanica</i>	Poaceae	Bel bamboo	construction
19	<i>Diospyros oocarpa</i>	Ebenaceae	Kendu	Agricultural implements; Beedi
20	<i>Diploknema butyraceae</i>	Sapotaceae	Jungli Mahua	Timber; firewood; Rice wine
21	<i>Ficus benghalensis</i>	Moraceae	Bargad	Wild edible
22	<i>Garcinia cowa</i>	Clusiaceae	cowa	Wild edible
23	<i>Hibiscus cannabimus</i>	Malvaceae		Culinary ingredient
24	<i>Hopea odorata</i>	Dipterocarpaceae	Thingam	Timber
25	<i>Korihalsia laciniosa</i>	Arecaceae	Lal beth	furniture
26	<i>Leea indica</i>	Leaceae	Bagoda balli	Rice wine; construction
27	<i>Licula peltata</i>	Arecaceae	Selai pathi	Construction
28	<i>Millettia andamanica</i>	Annonaceae	Jungli sagwan	Timber
29	<i>Myristica sp.</i>	Myristicaceae	Jaiphal	Medicinal

30	<i>Ocimum sanctum</i>	Lamiaceae	Tulsi	Honeybee repellent
31	<i>Orophea indica</i>	Annonaceae		Honeybee repellent
32	<i>Pandanus andamanesum</i>	Pandanaceae	Keora	Wild edible, construction
33	<i>Phoenix sylvestris</i>	Arecaceae	Kajur	Wild edible, construction
34	<i>Piper sp.</i>	Piperaceae	Jungli Pan	Betel leaves
35	<i>Pisonia umbellifera</i>	Nyctaginaceae	Bania	Elephant fodder, basket making
36	<i>Planchonia valida</i>	Myrtaceae	Lal Bombway	Veterinary medicine & Timber
37	<i>Pometia pinnata</i>	Sapindaceae	Thitkandu	Firewood; wild edible
38	<i>Pongamia pinnata</i> (L.) Pierre	Fabaceae	Karanj	Timber
39	<i>Pterocarpus dalbergioides</i>	Fabaceae	Padauk	Dyeing
40	<i>Pterocymbium tinctorium</i>	Sterculiaceae	Papita	Floaters, match sticks
41	<i>Pterospermum aceroides</i>	Sterculiaceae	Makehun; Ullat kambal	Medicinal; Agri. implements
42	<i>Rauwolfia serpentina</i>	Apocynaceae	Nagbel	Rice wine
43	<i>Rhizophora apiculata</i>	Rhizophoraceae	Khagadagach	Dyeing
44	<i>Sageraea elliptica</i>	Annonaceae	chooi	Timber
45	<i>Schleichera sp.</i>	Sapindaceae	Kusum	Construction; wild edible
46	<i>Semecarpus anacardium</i>	Anacardiaceae	Bhilawa	Wild edible
47	<i>Semecarpus anacardium</i>	Anacardiaceae	Kaju	Medicine
48	<i>Sida acuta</i>	Malvaceae	Boriyari	Medicinal
49	<i>Solanum xanthocarpum</i>	Solanaceae	Jungli Bengan	Medicinal
50	<i>Spondias pinnata</i>	Anacardiaceae	Ambara	Firewood; wild edible
51	<i>Stachytarpheta jamaicensis</i>	Verbenaceae	Billi asra	Cultural
52	<i>Terminalia catapa</i>	Combretaceae	Badam	Timber; wild edible
53	<i>Tetrameles nudiflora</i>	Datiaceae	Thitpok	Timber
54	<i>Tinospora cordifolia</i>	Menispermaceae	Kaduva bel	Ricewine
55	<i>Typhonia sp.</i>	Araceae		edible
56	Unidentified		Lohar lakdi	Timber
57	Unidentified		Karmi	Construction; firewood
58	Unidentified		Agia	Medicinal; construction; firewood
59	Unidentified		Yemane	Floaters
60	Unidentified	Arecaceae	Burma beth	Furniture making

Source: Ali (Unpubl.)

12. 17. Appendix 17: Marine turtle nesting sites around ANI

	Name of islands	Locality - Western Coast	Species
North Andamans			
1	Landfall	North western & eastern side	HB & GT
2	West	Western & eastern sides	GT
3	Whitecliff	Eastern side	GT
4	Reef	Eastern & north western sides	GT
5	Paget	Northern side	GT
6	Point	North eastern side	GT & HB
7	Snark	Around the island	GT & HB
8	Kwangtung	Western side	GT
9	Latouche	Northwestern side	GT & HB
10	North Reef	North eastern, north western & mid eastern sides	GT & HB
Eastern Coast			
11	East	North western & eastern sides	GT & HB

12	Pocock	Northern side	GT
13	Trilby	Northern side	GT & HB
14	Excelstor	Northern & eastern sides	GT & HB
15	Tage	Western side	GT
16	Dalgarno	South eastern & north western	GT & HB
17	East Turtle	Western side	GT
18	Temple	Eastern side	GT & HB
19	Rose	Western side	GT
20	Smith	Eastern side	GT & OR
21	Ross	Northeastern side	GT & HB
22	Craggy	Eastern side	GT & HB
23	Sound	South eastern side	GT & HB

Coastal Locations along North Andaman Island

24	Pine Bay	North west	GT
25	Beale Bay	North west	GT
26	Casuarina Bay	West	GT & OR
27	*Coffee Dera	North east	GT & LB*
28	Lamia Bay	East	GT
29	Ramnagar	East	LB & OR
30	Taralait Bay (Ramnagar)	South east	GT, HB & LB

*Leatherbacks nested in large numbers here, currently only 2-5 still nest at this site

MIDDLE ANDAMANS & RITCHIE'S ARCHIPELAGO

Name of island		Locality western coast	Species
1	Interview	South western coast	GT & HB
1	South Reef	All around	GT & HB
2	Anderson	South western side	GT
3	Tuft	Southeastern & South western sides	GT & HB
4	Hump	All around	GT & HB
5	Flat	All around	GT & HB

EASTERN COAST

6	Long	North eastern & south eastern	GT
7	North Passage	Eastern side	GT
8	East coast Baratang	Horsford, Rawlen's & Grieve Bays	GT & HB

COASTAL LOCATIONS

7	Robert Bay	West coast	GT
8	Karmatang*	East coast	GT*
9	Paikt Bay	East coast	GT & OR
10	Woteng	East coast	GT
11	Cuthbert Bay	East coast	OR, GT & LB

RITCHIE'S ARCHIPELAGO

19	North Button	Southern side	GT & HB
20	Middle Button	Southern side	GT & HB
21	South Button	North eastern side	GT & HB
22	North Passage	Eastern side	GT
23	Outram	Eastern side	GT
24	Havclock	South eastern -No-7 Radnagr beach	GT

25	English	South western side	GT & HB
26	Neil	North western side	GT & HB
27	Hugh Rose	Northern side	GT & HB

* Leatherbacks used to nest here up to mid 1980s

SOUTH ANDAMANS

	Name of island	Locality western coast	Species
1	Spike	South western side	GT
2	Bluff	North eastern & north western sides	GT & HB
3	Tarnugli	North western side	GT
4	Grub	Northern side	GT
5	Becke	Southern side	GT
6	Red skin	Southern side	GT
7	Boat	North eastern side	GT
8	Jolly Boy	North western side	GT
9	Rutland	Woodmason Bay, south & north eastern sides	GT, LB & OR
10	West Twin	Northern side	GT
11	East Twin	Northern side	GT
12	North Cinque	Western side	GT
13	South Cinque	Western side	GT
14	Passage	Northern side	GT
15	North Sister	North eastern side	GT
16	South Sister	South eastern side	GT
17	North Brother	Western side	GT
18	South Brother	Western side	GT

OTHER AREAS ALONG SOUTH ANDAMAN ISLAND

29	Iki Bay	West coast south Andaman Island	GT
30	Maduban beach	Eastern coast South Andaman Island- Harriet N P	GT & HB
31	Corbyan's Cove	South east of South Andaman Island	GT

LITTLE ANDAMAN ISLAND

1	South of Bumala Creek	West coast	GT
2	North and south of Jackson Creek	West coast	GT
3	West Bay	West coast	LB & GT
4	South Bay	West coast	LB & GT
5	North of Ifut Bay	East coast	GT & OR
6	Butler Bay	East coast	GT & OR

NICOBAR ISLANDS

	Name of island	Locality	Species
1	Car Nicobar	South western & southern	GT
2	Teressa	Western & North eastern	GT, HB, OR & LB
3	Katchal	West & South Bays	GT, HB, Or & LB
4	Meroc	Northern & western sides	GT & HB
5	Trak	Western side	GT & HB
6	Treis	Western side	GT & HB
7	Pulo Milo	Western side	HB

LITTLE NICOBAR WESTERN COAST

8	Pulo Kiyang		GT, HB & LB
9	Dahvu		GT, HB & LB

10	Pulo Baha		GT, HB & LB
11	Akupa & Maka Chua		GT & HB
12	Gota Bay		GT & HB
EASTERN COAST			
13	Pulo Pahan		GT
14	Pulo Ulan		GT
15	Bivaye	North of	GT
GREAT NICOBAR ISLAND- WEST COAST			
16	Rokoret		GT & LB
17	Renhong		GT & LB
18	Pulo Kunji		GT & LB
19	Casuarina Bay	North & South Dagma River mouth	GT, OR & LB
20	Alexandra River Mouth	North & South	GT, OR & LB
21	Pulo Bahi	South of	GT
EAST COAST			
22	Lliful Auch Creek	North of	GT & LB
23	Navy Dhara		GT & LB
24	Southeast G. Nicobar	Beach Opposite Pigeon Island	GT & LB
25	South Bay	North of the mouth of the Galathea River	LB & OR
26	Saphed Balu	South of Chingeni Village	GT, HB & LB

Source: Andrews & Tripathy, 2004. Species: **LB** Leatherback: **GT** – Green sea turtle; **HB** Hawksbill; **OR** – Olive ridley

12. 18. Appendix 18: List of PAs in ANI

NAME		AREA hectares	LOCATION
NATIONAL PARKS			
1	Saddle Peak National Park	3,254.88	North Andaman Island, Eastern side
2	Rani Jhansi Marine National Park	25,614.00	Ritchie's Archipelago
3	Mount Harriet National Park	4,662.00	North east– South Andaman
4	Mahatma Gandhi Marine National Park	28,150.00	South of South Andaman Island
5	Campbell National Park	42,623.00	North west of Great Nicobar Island
6	Galathea National Park	11,000.00	South east Greta Nicobar Island
BIOSPHERE RESERVE			
1	Great Nicobar Biosphere Reserve	88500.00	Great Nicobar Island
SANCTUARIES- NORTH ANDAMANS			
1	Landfall Island	2,848.00	North of North Andaman
2	West Island	640.00	North west of North Andaman
3	Beele Island	8.00	North west of North Andaman
4	White Cliff Island	47.00	North west of North Andaman
5	Reef Island	174.00	North west of North Andaman
6	Turtle Island	39.00	North west of North Andaman
7	Paget Island	736.00	North west of North Andaman
8	Point Island	307.00	North west of North Andaman
9	Sherme Island	785.00	North west of North Andaman
10	Snark Island	60.00	West of North Andaman
11	Kwangtung Island	57.00	West of North Andaman
12	Lotouche Island	96.00	West of North Andaman
13	North Reef Island	348.00	West of North Andaman
14	East Island	611.00	South east of Landfall Island
15	Pocock Island	62.00	East of North Andaman

16	Excelsior Island	169.00	East of North Andaman
17	Table Island	229.00	East of North Andaman
18	Trilby Island	96.00	East of North Andaman
18	Temple Island	104.00	East of North Andaman
20	Turtle Island	39.00	East of North Andaman
21	Narcondam Island	681.20	East of North Andaman
22	Ross Island	101.00	East of North Andaman
23	Egg Island	5.00	North Andaman Island
24	Oliver Island	16.00	North of North Andaman
25	Orchard Island	10.00	North of North Andaman
26	Ox Island	13.00	North of North Andaman
27	Oyster Island- 1	8.00	North Andaman
28	Oyster Island- 2	21.00	North Andaman
29	Jungle Island	52.00	North Andaman
30	Brush Island	23.00	North Andaman
31	Channel Island	18.00	North Andaman
32	North Island	49.00	North Andaman
33	Tree Island	3.00	North Andaman
34	Wart Island	11.00	North Andaman
35	Entrance Island	96.00	North west North Andaman
36	Gander Island	5.00	North Andaman
37	Goose Island	1.00	North Andaman
38	Gurjan Island	16.00	North Andaman
39	Cone Island	65.00	North Middle Andaman
40	North Curlew Island	3.00	North of Middle Andaman
41	South Curlew Island	16.00	North Andaman

SANCTUARIES- MIDDLE ANDAMANS

1	Swamp	409.00	North of Middle Andaman
2	Dot Island	18.00	North of Middle Andaman
3	Dottrel Island	13.00	North of Middle Andaman
4	Parkinson Island	34.00	North of Middle Andaman
5	Interview Island	13,300.00	North west Middle Andaman
6	Snake Island	73.00	North west Middle Andaman
7	Bondoville Island	255.00	North west Middle Andaman
8	Buchanan Island	933.00	North west Middle Andaman
9	Surat Island	31.00	North west Middle Andaman
10	Bennett Island	346.00	North west Middle Andaman
11	Bingham Island	8.00	North west Middle Andaman
12	Blister Island	26.00	North west Middle Andaman
13	Roper Island	146.00	North west Middle Andaman
14	Ranger Island	426.00	North west Middle Andaman
15	South Reef Island	117.00	North west Middle Andaman
16	Mask Island	78.00	North west Middle Andaman
17	Mayo Island	10.00	North West Middle Andaman
18	Tuft Island	29.00	West of Middle Andaman
19	Hump Island	47.00	West of Middle Andaman
20	Flat Island	936.00	West of Middle Andaman
21	Cuthbert Bay Turtle Sanctuary	582.00	East of Middle Andaman
22	Barren Island	811.00	East of Middle Andaman
23	North Button Island	44.00	East of Middle Andaman

24	Middle Buton Island	64.75	East of Middle Andaman
25	South Buton Island	3.80	East of Middle Andaman
SANCTUARIES- SOUTH ANDAMANS			
1	Talakaicha	321.00	Baratang Island
2	Mangrove Island	39.00	East of Baratang Island
3	Arial Island	5.00	East of Baratang Island
4	Bamboo Island	5.00	East of Baratang Island
5	Ducan Island	73.00	East South Andaman
6	Petman Island	137.00	East of South Andaman
7	Kyd Island	805.00	East of South Andaman
8	English Island	355.00	East in the Ritchie's Archipelago
9	Sir Hugh Rose	106.00	South- Ritchie's Archipelago
10	Snake Island	3.00	South east South Andaman
11	Petre Island	13.00	West of South Andaman
12	Defence Island	1,049.00	West of South Andaman
13	Clyde Island	54.00	West of South Andaman
14	Potanma Island	16.00	West South Andaman
15	James Island	210.00	West South Andaman
16	Rowe Island	1.00	West South Andaman
17	Montgomery Island	21.00	West of South Andaman
18	Lohabarriek Crocodile Sanctuary	2,221.00	South west of South Andaman
19	Tarmugli Island	2,333.00	South west of South Andaman
20	South Sentinel Island	161.00	South West of South Andaman
21	Sandy Island	158.00	West of South Andaman
22	West & East Twins Islands	184.00	South of Rutland Island
23	North & South Cinque Islands	953.00	South east Rutland Island
24	Passage Island	62.00	South of South Cinque Island
25	North & South Sisters Island	36.00	South east of Passage Island
26	North Brother Island	75.00	North east of Little Andaman Island
27	South Brother Island	124.00	North east of Little Andaman
SANCTUARIES- NICOBARS			
1	Batti Malv Island	223.00	South east of Car Nicobar Island
2	Tillanchang Island	1,683.00	South east of Batti Malv Island
3	Megapode Island	12.50	South west of Great Nicobar Island

Source: AN E & F. 2005

12. 19. Appendix 19: Important Bird Areas in ANI

Site names Andaman Group	Site code	Status	IBA Criteria
1 Little Andaman Island	IN-AN-10	TR	A1, A2
2 South Sentinel Island	IN-AN-15	WLS	A1, A2
3 North Sentinel Island	IN-AN-15	TR	A1, A2
4 Mahatma Gandhi Marine	IN-AN-11	NP	A1, A2
5 Kadakachang wetlands	IN-AN-08	PF	A1, A2
6 Baratang – Rafter's Creek	IN-AN-02	PF	A1, A2
7 Mount Diavalo & Cuthbert Bay	IN-AN-12	PF & WLS	A1, A2
8 Chainpur and Hanspuri	IN-AN-04	PF	A1, A2
9 Jarawa Reserve (Middle & South Andaman Islands)	IN-AN-7	TR	A1, A2
10 Jarawa Reserve (South Andaman)	IN-AN-7	TR	A1, A2
11 Austin Strait	IN-AN-01	PF	A1, A2
12 Interview Island	IN-AN-06	WLS	A1, A2

13	Landfall Island	IN-AN-09	WLS	A1, A2
14	Mount Harriet-Shoal Bay	IN-AN-13	NP	A1, A2
15	Narcondam Island	IN-AN-14	WLS	A1, A2
16	North Reef Island	IN-AN-16	WLS	A1, A2
17	Saddle Peak	IN-AN-18	NP	A1, A2
18	Rani Jhansi MNP-Outram, John & Henry Lawrence Islands	IN-AN-17	NP	A1, A2
Site names Nicobar Group				
19	Car Nicobar Island	IN-AN-03	TR	A1, A2
20	Tilangchong Island	IN-AN-19	TR & WLS	A1, A2
21	Camorta Island	IN-AN-19	TR	A1, A2
22	Katchal Island	IN-AN-19	TR	A1, A2
23	Nancowary Island	IN-AN-19	TR	A1, A2
24	Trinkat Island	IN-AN-19	TR	A1, A2
25	Little Nicobar Island	IN-AN-19	TR	A1, A2
26	Great Nicobar Island	IN-AN-05	TR	A1, A2

Source: Zafar-ul Islam & Rahmani (2004). A1- Threatened Species; A2- Endemic Bird Area.
TR- Tribal Reserve; NP- National Park, WLS- Wildlife Sanctuary; PF- Preserved Forest.

12. 20. Appendix 20: Rare, endangered and threatened plants

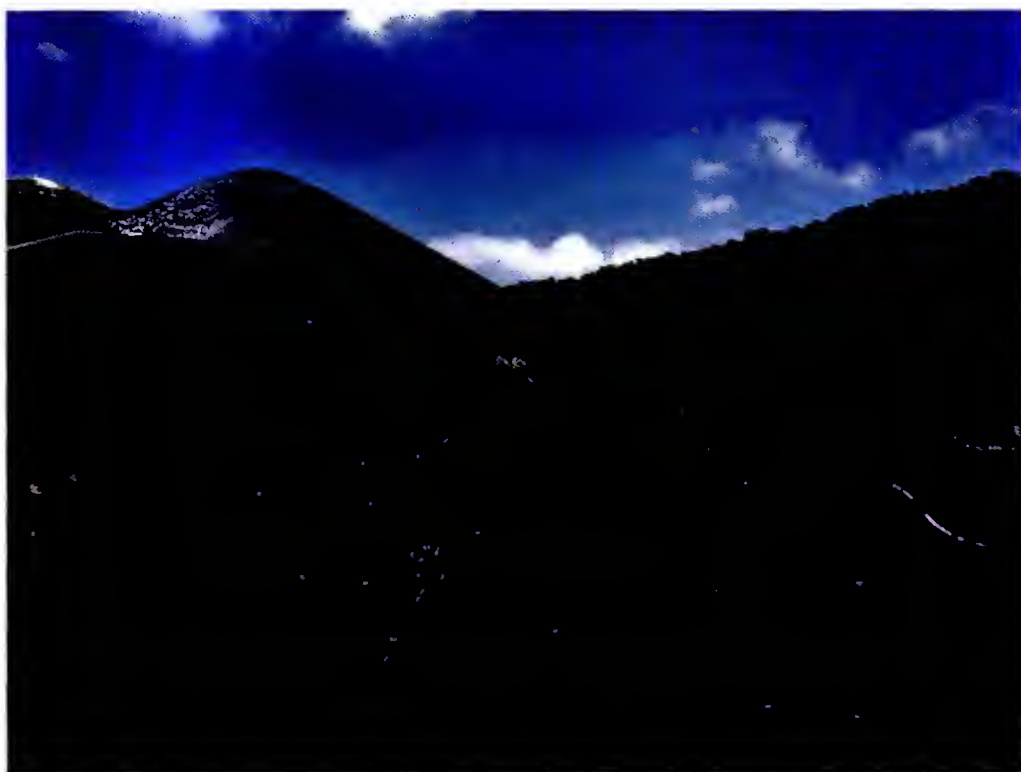
Family	Species	Remarks
Nyctaginaceae	<i>Nypa fruticans</i>	Critical
Araceae	<i>Amarphophallus carnosus</i>	Rare & Threatened
	<i>Amarphophallus longistylus</i>	Rare & Threatened
	<i>Amarphophallus oncophyllus</i>	Rare & Threatened
Arecaceae	<i>Calamus dilaceratus</i>	Rare & Threatened
	<i>Corypha macropoda</i>	Rare & Threatened
Cyperaceae	<i>Cyperus kurzii</i>	Rare & Threatened
	<i>Hypolytrum balakrishnamii</i>	Rare
Dioscoreaceae	<i>Dioscorea vexans</i>	Rare
	<i>Dioscorea rogersii</i>	Rare
Marantaceae	<i>Stachyphrynium cadellianum</i>	Rare & Threatened
Orchidaceae	<i>Bulbophyllum protractum</i>	Rare & Threatened
	<i>Habenaria andamanica</i>	Rare & Threatened
	<i>Malleola andamanica</i>	Rare & Threatened
	<i>Phalaenopsis speciosa</i>	Rare & Threatened
	<i>Smittlandia helferi</i>	Rare & Threatened
	<i>Taeniophyllum andamanicum</i>	Rare & Threatened
	<i>Zeuxine roffiana</i>	Rare & Threatened
Poaceae	<i>Zeuxine andamanica</i>	Rare & Threatened
	<i>Oryza indandamanica</i>	Rare
	<i>Busenbergia albo-lutea</i>	Rare
Zingiberaceae	<i>Globba pauciflora</i>	Rare
	<i>Kaempferia siphonantha</i>	Rare & Threatened
Acanthaceae	<i>Hypoestis andamanensis</i>	Rare & Threatened
	<i>Hypoestis thoithathrii</i>	Rare
	<i>Strobilanthes andamanensis</i>	Rare & Threatened
Anacardiaceae	<i>Mangifera andamanica</i>	Rare & Threatened
Annonaceae	<i>Orophaea torulosa</i>	Rare
Asteraceae	<i>Vernonia andamanica</i>	Rare & Threatened
Bombacaceae	<i>Bombax insignis</i>	Rare

Clusiaceae	<i>Garcinia cadelliana</i>	Rare
	<i>Garcinia kingii</i>	Rare
	<i>Mesua manii</i>	Rare
Euphorbiaceae	<i>Anidesma andamanicum</i>	Rare
	<i>Bridelia kurzii</i>	Rare
	<i>Cnesmone javanica</i>	Rare
	<i>Dimorphocalyx balakrishnanii</i>	Rare
	<i>Dimorphocalyx dilipanus</i>	Rare
	<i>Glochidion bilobulatum</i>	Rare
	<i>Phyllanthus andamanica</i>	Rare & Threatened
	<i>Sphyranthera airy-shawii</i>	Rare
	<i>Sphyranthera hutescens</i>	Rare
	<i>Trigonostemon viridissimus</i>	Rare & Threatened
Fabaceae	<i>Tadehagi triquetrum</i>	Rare & Threatened
Flacourtiaceae	<i>Casuarina insularis</i>	Rare
Hypocrateae	<i>Hippocratea andamanica</i>	Rare
Icacinales	<i>Gomphandra comosa</i>	Rare
Lamiaceae	<i>Scutellaria andamanica</i>	Rare
Lauraceae	<i>Cryptocarya ferrarsii</i>	Rare
	<i>Litsea kurzii</i>	Rare
	<i>Litsea leiantha</i>	Rare
	<i>Neolitsea andamanica</i>	Rare
	<i>Neolitsea balakrishnanii</i>	Rare & Threatened
Loganiaceae	<i>Strychnos narcondamensis</i>	Rare
Loranthaceae	<i>Ginalloa andamanica</i>	Rare & Threatened
Malpighiaceae	<i>Hiptage thothatharii</i>	Rare & Threatened
Melastomataceae	<i>Memecylon collinum</i>	Rare
Meliaceae	<i>Aglais fusca</i>	Rare
	<i>Anoora manii</i>	Rare
Menispermaceae	<i>Stephania andamanica</i>	Rare
	<i>Tinospora andamanica</i>	Rare
Moraceae	<i>Ficus andamanica</i>	Rare
Myristicaceae	<i>Horsfieldia macrocarpa</i>	Rare
Myrsinaceae	<i>Maesa andamanica</i>	Rare
Myrtaceae	<i>Syzygium andamanicum</i>	Rare
	<i>Syzygium kurzii</i>	Rare
	<i>Syzygium manii</i>	Rare
Oleaceae	<i>Jasminum andamanicum</i>	Rare
	<i>Jasminum unifoliolatum</i>	Rare
Rubiaceae	<i>Diplospora andamanica</i>	Rare & Threatened
	<i>Ixora andamanica</i>	Rare & Threatened
	<i>Ixora capituliflora</i>	Rare
	<i>Ixora hymenophylla</i>	Rare
	<i>Nauvlea gageana</i>	Rare
	<i>Prismatomeria andamanica</i>	Rare
	<i>Psychotria andamanica</i>	Rare
	<i>Psychotria balakrishnanii</i>	Rare & Threatened
	<i>Psychotria helferi</i>	Rare
	<i>Psychotria pendula</i>	Rare
	<i>Psychotria polynura var. longipetiolata</i>	Rare
	<i>Pubistylis andamanensis</i>	Rare & Threatened
Verbenaceae	<i>Clerodendrum jankawense</i>	Rare
Vitaceae	<i>Tetrastigma andamanicum</i>	Rare



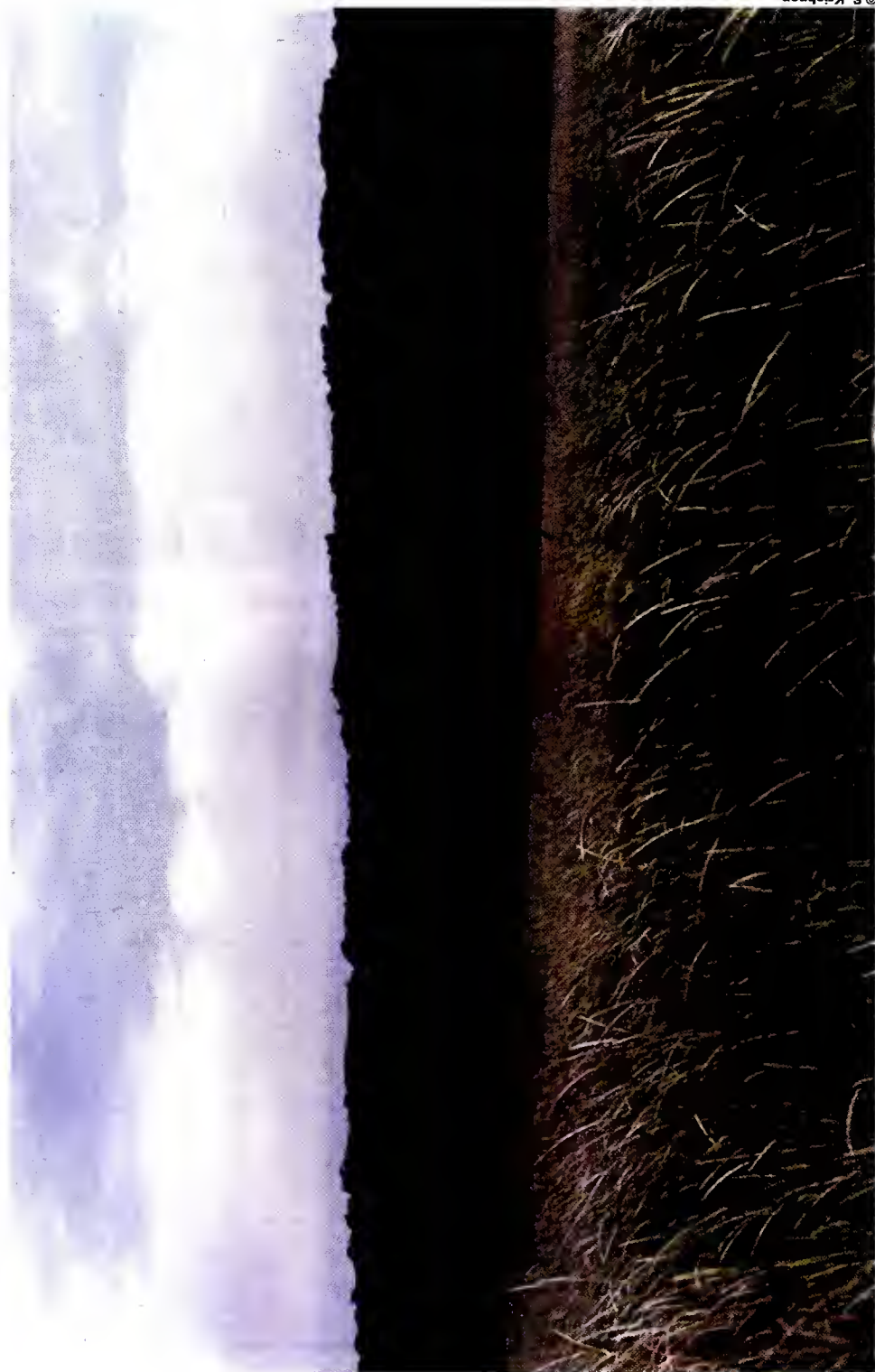
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Plate 1. Galathea River – Great Nicobar Island



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Plate 2. Barren Island



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Plate 3. Grasslands and forest type on Teresa Island, Nicobars



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Plate 4. Mangroves and last of the Great Andamanese people



© M. Chand

Plate 5. Onge men hunting in inland wetland forest – Little Andaman Island



© M. Chandi

Plate 6. *Nypa fruticans* strands – South Andamans



© M. Chandi

Plate 7. Mohwa (*Manilkara littoralis*) littoral forest – Andamans



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Plate 8. Homestead and plantation along protected forest - Wandoor, South Andaman



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Plate 9. Freshwater resource along protected forest and settlement - Karamatang, Middle Andaman



Plate 10. Hamlet along coastal area – Chowra Island, Nicobars

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Plate 11. Hamlet and plantation along littoral forest – Makachua, Little Nicobar Island

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Plate 12. Resource use by settled fishermen – shark fin harvest



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Plate 13. Resource use by Bengali settlers – cane and bamboo



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Plate 14. Resource use by Onge people – wild boar



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Plate 15. Resource use by Nicobari people – pandanus (*Pandanus lerram*)



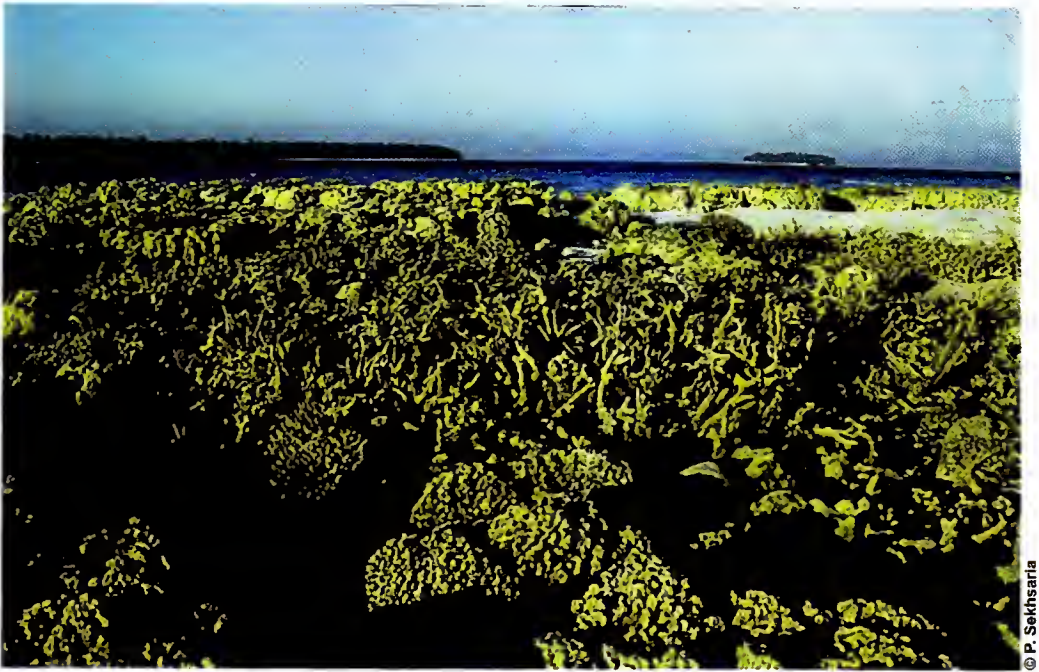
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Plate 16. Post tsunami uplifted creek Coffrie Bay, North Andamans



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Plate 17. Mangrove strands drying post tsunami upliftment of Middle Andamans



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Plate 18. Post tsunami reef flat upliftment – North Reef Island



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Plate 19. Post tsunami inundation of agricultural land – South Andaman Island



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Plate 20. Post tsunami inundation of agricultural land – South Andaman Island



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Plate 21. Inundation of coastal habitat – South Bay, Great Nicobar Island



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Plate 22. Inundation of coastal habitat – PuloBed, Great Nicobar Island



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Plate 23. Inundation of coastal habitat – South Bay, Great Nicobar Island



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